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LOCOMOTIVE GRATES.

By M. N. Forney.

The letter of C. G. O. on this subject on page 260 of the August number of the "American Engineer" suggests some observations. The general principle, which has been enunciated, that: "Within the limits of weight and space to which a locomotive boiler is necessarily confined it cannot be made too large" is undoubtedly sound, but, as was suggested in the discussion at the Master Mechanics' Association, it is not so clear what proportion the grate area and the cubical contents of the fire-box should bear to the heating surface under any given conditions. In considering this question, two requirements must be kept in mind—1st, the maximum capacity of the locomotive to do work must be maintained, that is, it must be able to pull the heaviest possible load at the required speed, and 2nd, it should do this with a minimum consumption of fuel. Often these conditions are contradictory, that is, in order to pull the heaviest loads a locomotive must sometimes waste fuel, and, in many cases, it is more economical to do so than it would be to save coal by reducing the load hauled.

But suppose that in designing an engine every expedient and resource is adopted to reduce the weight of the parts. Having this object in view, the fact that small wheels weigh less than big ones would incline the designer to use the smallest driving-wheels which would be adapted to the service in which the engine is to be used. With wheels of reduced diameter smaller cylinders will be required, and lighter connections, axles, frames, etc., may be used. It will be supposed further that steel and wrought-iron are substituted, as far as possible, for cast-iron, that all the castings are redesigned, and their weight is diminished to the lowest possible limit consistent with safety, and that every detail of the machine is subjected to the scrutiny of the most skillful designers and the weights of all the parts are reduced as much as is practicable. If by these expedients the weight of the parts outside of the boiler are reduced, say 5,000 pounds, then, obviously, the boiler may be that much heavier without increasing the total weight of the locomotive. Furthermore, in choosing the plan of boiler let due consideration be given to the weights of the respective forms—which is not often done—and let the lightest form be selected. By the exercise of intelligence and the adoption of the expedients suggested it is not unreasonable to assume that a design for a locomotive of a given weight might be evolved, the boiler of which would have several hundred square feet more of heating surface than ordinary locomotives of a similar class. Now, with the increased heating surface, there would be much less difficulty in making steam at critical periods and with inferior fuel than there would be if the boiler was smaller. The difficulty with many—perhaps most—locomotives is that they have insufficient boiler capacity to produce the maximum amount of steam required at some times and places. Consequently a large area of grate is required in order to consume the greatest possible quantity of fuel, and to do this a tremendous blast must be maintained, with all the evils of a high back pressure, and while great quantities of fuel are consumed, much of it escapes out of the chimney either in a solid or unburned gaseous form. At the same time the products of combustion must traverse the heating surfaces so rapidly that there is not time to transmit their heat to the water on the other side, and they escape out of the chimney at temperatures of from 800 to 1,000 degrees. An enormous waste is the result.

If the same quantity of fuel was consumed in a larger boiler, having more heating surface, it would generate more steam because the products of combustion would be exposed to more heating surface and for a longer time. Therefore less fuel need be burned to produce a given quantity of steam, and consequently the rate of consumption on the grate could be reduced with a corresponding improvement in the combustion and a resulting further economy. Paradoxical as it may seem, it would appear that with a boiler of ample size a smaller grate may be used than is required to produce the maximum results with insufficient heating surface.

But supposing that the boiler has been made as large as possible, the proper proportion of grate to the heating surface is still an open question. Of course much depends upon the quality of the fuel. If it is inferior, more must be burned to produce a given quantity of steam than would be required if it was of better quality, from which the well recognized inference is drawn that a larger grate is required with bad fuel than with good. The relation which should exist between the size of the grate and the quantity of the fuel will not be discussed now, attention will only be called to the general fact that a grate should always be large enough to consume enough of the poorest fuel that is used to supply the engine with steam at critical times and places, or when it is working hardest, which is usually on grades, or perhaps at points on the road where grades and curves occur simultaneously. Now, a grate large enough to burn sufficient of the poorest fuel which is used, to supply enough steam when the locomotive is working hardest, is quite sure to be too large when the engine is not working at its maximum capacity as on easy grades or on level parts of the line. This suggests that the size of the grate should be made variable. With this end in view a few years ago the writer designed such a grate, but which thus far has not been subjected to any other trial excepting that which it had to encounter in the Patent Office. The description of it in the patent specifications is perhaps as lucid as any which could be given and is therefore quoted:

In the operation of all steam and of some other classes of boilers, as well as in that of the various types of furnaces, the requirements of heat generation vary materially from time to time, a high degree of heat being necessary during certain periods and different lower degrees during others. This is notably the case in locomotive boilers, in which a large amount of steam must be generated when the engine is pulling heavy trains at high speeds or ascending steep grades, while on levels or descending grades or during stoppages much less heat is required. Therefore at certain times the fire must be stimulated to its utmost capacity and at others little or no steam need be generated, there being frequently occasions, as when standing at stations, in which steam generation is inconvenient as well as wasteful. It has been found in practice that substantial economy in the combustion of fuel is attained if there is great intensity of combustion—that is, if the draft of air through the fire is concentrated—and that if the aggregate area of the openings for the admission of air through the fire is greater than that which is required to generate a desired and determined amount of heat and steam the combustion is wasteful. For this reason it becomes desirable to regulate the aggregate area of air admission openings proportionately to the quantity of heat which may be demanded, for which purpose these improvements are designed and are desirably applicable without modification of other elements in fire boxes of any of the present constructions.

In the accompanying engravings, Fig. 1 is a vertical longitudinal central section through a locomotive fire box having my improvements applied; Fig. 2, a sectional plan of the same at the line x x of Fig. 1; Fig. 3, an end view as seen from the rear; Fig. 4, a transverse section at the line y y of Fig. 1; Fig. 5, a longitudinal section, on an enlarged scale, through the rear end portion of the fire box, showing the grate bars in vertical position; and Fig. 6, a similar section showing the bars as turned into a substantially horizontal position. The invention is particularly designed for use in connection with locomotive engine fire boxes, and is herein illustrated as applied in a rectangular fire box of such type, but is obviously equally applicable to furnaces of other descriptions. The grate bars, which are of the rocking class, are set transversely in the fire box 1, and are in this instance shown as made in triplet sections, composed of a central bar 2 and lateral bars 3 3, cast in a single piece and separated one from another (except as to connecting webs between

the bars) by intermediate air passages 4. Each section is provided with end journals or trunions, which rest in segmental recesses in bearing bars 7, secured longitudinally in the fire box adjacent to its bottom. The grate sections are set at such distance apart that the transverse spaces 8 in the fire box between the outer bars of adjacent sections shall be equal in width, as nearly as may be, to the air passages 4 between the bars of the sections, said spaces, together with the passages 4, serving, when the bars stand in vertical position, to admit air from the ashpan 9 to and through the body of fuel supported upon the grate in the usual manner.

In order to enable the aggregate area of air admission through the grate to be regulated as from time to time desired, the grate bars are so constructed and relatively located that when turned horizontally, or nearly so, the air admission spaces above described shall be closed by the overlapping of the bars and the passage of air through said spaces consequently prevented. To this end the central bar 2 of each of the grate sections is projected above and below the planes of the upper and lower faces of the lateral bars 3 3, so that the sections being set at a proper distance apart the upper portion of the central bar of one section will overlap the lower portion of the central bar of an adjacent section when both are turned into substantially horizontal position, as shown in Fig. 6, and in the rear portion of the fire box in Fig. 1, the air admission passages between the bars and between the sections being thereby closed by said central bars, the traverse of which into and out of horizontal abutting position is unimpeded by reason of the lesser depth of the lateral bars.

To facilitate the turning of the grate bars, it is essential that the spaces between the sections should be maintained of uniform width, inasmuch as if these spaces should be contracted in the act of turning the bars, there is liability of cinders and coal becoming wedged between them, so as to prevent them from being moved. For this purpose the upper faces of the bars, or those adjacent to the fire, are curved in contour concentrically with the journals of the grate sections, as shown most clearly in the enlarged transverse sections, Figs. 5 and 6, and there being, consequently, no projection of any portion of said surfaces beyond the curved plane of traverse of the edges of the bars in being turned in their bearings the width of the space 8 between a bar which is moved and an adjoining stationary bar is neither increased nor diminished in the movement of the former.

The several grate sections are adapted to be turned from vertical to horizontal position, and vice versa, in groups or series of any desired number, so that a greater or less area of air admission passages may be closed or left open, as required. Each section is provided with a downwardly projecting arm 10, which is coupled at its lower end to a separate horizontal bar 11. The rear ends of the bars 11 are coupled to the lower ends of levers 12, which are journaled upon a common pivot 12, attached to the frame or to the foot-plate 14 in rear of the fire box. The levers 12 may project above the foot-plate, as shown, or they may be entirely below it, if desired, and the grate bars are moved by a removable hand lever 15, having a socket in its lower end adapted to engage the ends of the levers 12. A separate rocking lever 12 and connecting bar 11 are in the instance shown provided for each grate section; but, if preferred, a group of two or more sections may be coupled to a single lever and connecting bar. A dog or latch 16 is pivoted to each of the levers 12 in position to engage either of a pair of notches or shoulders on a segment 17, fixed to the foot-plate or other convenient part of the engine, so as to hold the lever 12 in forward or backward position, and thereby maintain the connected grate section or sections in vertical or in horizontal position, respectively.

What the result of a practical test of this device would be it is of course impossible to say in advance. Perhaps the result to be apprehended is, that the grate bars would be so warped and twisted by the heat of the fire as to become unworkable, and then again perhaps they would not.

The possibility of making a grate, the active area of combustion of which may be made variable, leads to further observations. At the Master Mechanics' convention last June the deduction of D. K. Clark was quoted that the larger the heating surface and the smaller the grate, provided you can burn enough fuel in it, the greater the economy. In his Railway Machinery he says: "Practically there can never be too much heating surface, as regards economical evaporation, but there may be too little; on the other hand, there may be too much grate area for economical evaporation, but there cannot be too little so long as the required rate of combustion does not exceed the limits to be defined." Again he said: "The grate should be kept as small as is consistent with the demand for steam, and the practicable rate of combustion. On the other hand there can be no economical objection to any amount of heating surface which can be got into a boiler, even though greater than the economic limits." It has been pointed out that enlarging the grate increases the maximum steaming capacity of a boiler, for the reason that more fuel can be consumed in a large grate than in a small one, but the addition to the steaming capacity is made with a reduction of economy. It then follows that if the area of the grate is increased to meet the requirements of the greatest demands for steam when the engine is working hardest it will be very much too large for economy when under ordinary conditions of working. Or in other words, if the area of the grate could be reduced when a locomotive is not working hard, a material economy in the consumption of fuel would result. This is the object aimed at in designing the grate illustrated herewith, and it is thought would be attained if no serious practical difficulties are encountered in its use.

The reason why it is more economical to burn a given quantity of fuel in a small grate than in a large one is due in part to the fact that with a rapid rate of combustion higher temperatures are produced in the fire, and as the transmission of

FIG. 1.

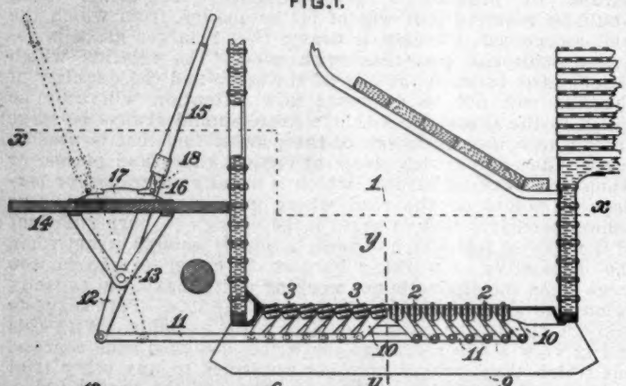


FIG. 2.

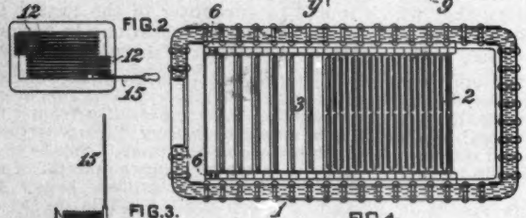


FIG. 3.

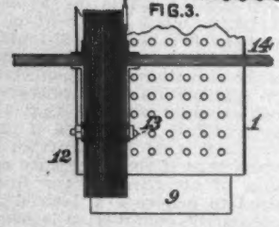


FIG. 4.

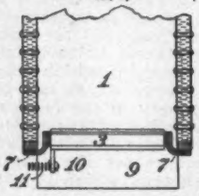


FIG. 5.

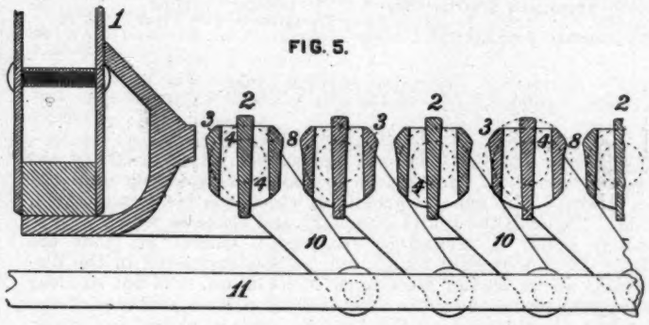
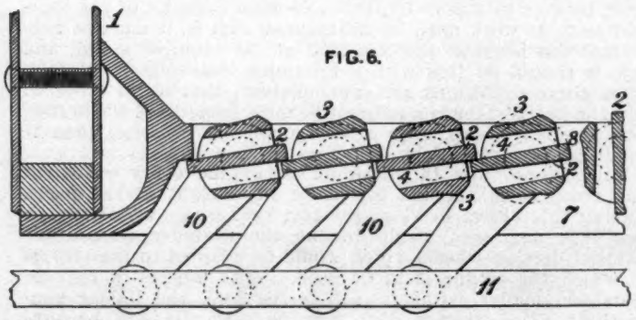


FIG. 6.



Locomotive Grates—M. N. Forney.

heat to the water is proportioned to the difference in temperature in the two sides of the heating surfaces, a larger proportion of the heat is absorbed by the water when there is a great difference than when there is little. Besides this, if the temperatures are high, the volume of the products of combustion containing a given number of units of heat is less than it is if the temperature is lower. Or in other words, with a small grate and a rapid rate of combustion there will be fewer cubic feet of smoke and gases to convey from the fire to the chimney; consequently their movement may be slower and more time will thus be given for the transmission of their heat to the surfaces with which they are in contact.

Of course the size of the grate must be adapted to the quality of the fuel. With a poor fuel more must be burned to produce a certain quantity of steam in a given time, and therefore with such fuel a larger grate will be required. Kent, in his excellent Pocket Book for Mechanical Engineers, says:

"With good coal, low in ash, approximately equal results may be obtained with large grate-surface and light draught, and with small grate-surface and strong draft, the total amount of coal burned per hour being the same in both cases. With good, bituminous coal, low in ash, the best results, apparently, are obtained with strong draught and high rates of combustion, provided the grate-surfaces are cut down so that the total coal burned per hour is not too great for the capacity of the heating surface to absorb the heat produced." This indicates what is undoubtedly true, that the draught must be adapted to the size of the grate, and the quality of the fuel. A stronger draught is required if a small grate is used than is needed with a larger one.

Very little attention seems to have been given thus far to the proportion which the volume of space in the fire-box, above the grate, should bear to its area. It is believed that the relation of these to each other is of much more importance than is ordinarily supposed. Some years ago Frederich Siemens in a paper on combustion, and the construction of furnaces—which has heretofore been quoted in these pages—called attention to the fact that whenever flame comes in contact with any solid substance combustion is arrested, which fact, he said, could be illustrated by putting a rod into the flame of an ordinary gas light, which would then immediately begin to smoke. His inference was that furnaces should be constructed so as to keep the flame out of contact with their sides and tops until the process of combustion is completed. A homely illustration of the embodiment of this principle is ordinary egg-shaped stoves for burning bituminous coal. They have grates comparatively small in area, and the space above them swells out to an approximately pear-shaped form. The enlarged space above the fire gives room for combustion to take place before the gases pass into the chimney. A similar form is adopted for smelting furnaces and cupolas. The design of ordinary locomotives is such that the available width of their fire-boxes is usually limited by the space between the frames or between the wheels. Comparatively narrow fire-boxes are therefore the rule. The fire-boxes of the Wootten boiler are placed above the wheels so that they may be made as wide as the cab, but with a diminished depth. The adoption of the Columbia and Atlantic types of engines, with their fire-boxes entirely behind the driving-axles, will make wider fire-boxes possible, and open a new era in their proportions, which invites attention to the relation which should exist between the volume of space in the fire-box, and the size of the grate. It seems probable that the amount of this space has a very important bearing on the economy of fuel consumption. We are certainly now very much in the dark with reference to the whole matter. If the possibility of a saving of a few thousand dollars by litigation can be shown to a railroad company, they usually show no hesitation in employing the most able lawyers to represent and advocate its interests, but, quite curiously, when it can be shown almost to a demonstration that an investigation requiring engineering knowledge, skill and experience would save many thousands of dollars, it is difficult to induce them to expend a cent for such information.

Consideration of the question of combustion has suggested the following conclusions: First, there should be as much heating surface as the limits of weight and space will permit; second, the grate should be large enough to burn sufficient coal to generate sufficient steam to supply the engine when it is doing its maximum work. The area of grate required for this will depend upon the quality of the fuel. Third, if practicable, the grate ought to be adjustable, so that its active area may be diminished or increased to meet the varying conditions of working. Fourth, the length and depth and breadth of the fire-box should be as nearly alike as is practicable, so as to keep the flame out of contact with its sides and top, and thus give time for combustion to take place, and for the same reason dead-plates should be put around the grate, next the sides and ends of the fire-box.

THE TRAVELING ENGINEERS' ASSOCIATION.

The sixth annual convention of the Traveling Engineers' Association was held at Buffalo, beginning September 13. The reports were interesting and practical, as usual, but they are so long that we cannot do more than call attention to the chief of the points involved in them. The first subject was:

What is the Best Method to be Pursued by Traveling Engineers in Giving Air Brake Instruction While on the Road?—A great deal of very good advice is given in this paper, which is of equal value to old traveling engineers as to new ones. The first principle laid down is that instructors should themselves become proficient in all of the duties of engineers, and should be prepared to handle brakes on any part of the road. Many of the common practices that are wrong are deprecated, among which are the wasting of air by unnecessary applications and releases, and the holding of the brakes too long and giving a disagreeable lurch to the train by too late release. The causes of the sticking of brakes are important, and enginemen should be familiar with them. The effect of a partially closed angle cock in the train upon the noise of the train pipe exhaust should be understood, and this was not given enough attention by engineers. The influence of piston travel and the effect of closed retaining valves were considered. The proper method of handling trains partly equipped with air brakes was stated to be directly opposite to the method required on the Chicago, Rock Island & Pacific. The hand brakes should be set on the cars immediately behind the air braked cars, as that is the place where the slack may be controlled. Independent driver brakes and the use of retaining valves on locomotives to assist in making tank stops are considered along with a number of other important details.

How Can the Traveling Engineer Best Instruct and Assist the Fireman in the Economical Firing of the Locomotive?—The essence of this report is that the traveling engineer should be thoroughly prepared to do that which he is expected to instruct others to do. The necessity of getting trains over the road and on time must not be lost sight of, and with due consideration of this the engineman should be brought to see his responsibility for the proper use of the fuel handled by the fireman. It is a wise plan to furnish firemen with good literature on the subject of combustion in locomotive fireboxes, and the practice of traveling engineers in riding with new firemen until they are thoroughly qualified to do their work economically is recommended. Encouragement of the men is advocated. The draft appliances are often to blame for waste of fuel, and more attention to the front end arrangements was shown to be necessary.

Uniformity of Cab Fittings.—The steam connections to the boiler should all be combined in one fitting or combination stand, making but one connection with the boiler. The throttle should be so located that it might be reached by the engineer when leaning out of the window, and in short the arrangement of the cab fittings should be made with reference to the convenience of the men. It was very desirable to have the engines arranged with uniformity, and standards were advocated.

Lubrication of Locomotives.—This report was prepared from answers to questions asked by the committee, and is divided into three parts: First, proper fitting of bearings; second, quality of lubricant; third, manner of applying the lubricant to the bearings. The burnish or roller finish is advised for all journals and crank pins. There was a difference of opinion as to the proper maximum length of run for one oiling, but the committee thought that 100 miles was about right. The oiling of the driving boxes, shoes and valve gear should be done as late as possible before starting, and it was recommended that the work of packing, driving and truck boxes should be placed in the hands of a competent man, who should attend to all of this work. The practice of facing the hubs of driving wheels with Babbitt metal was endorsed, and the use of oil cans fitted with valves to regulate the flow of oil was recommended.

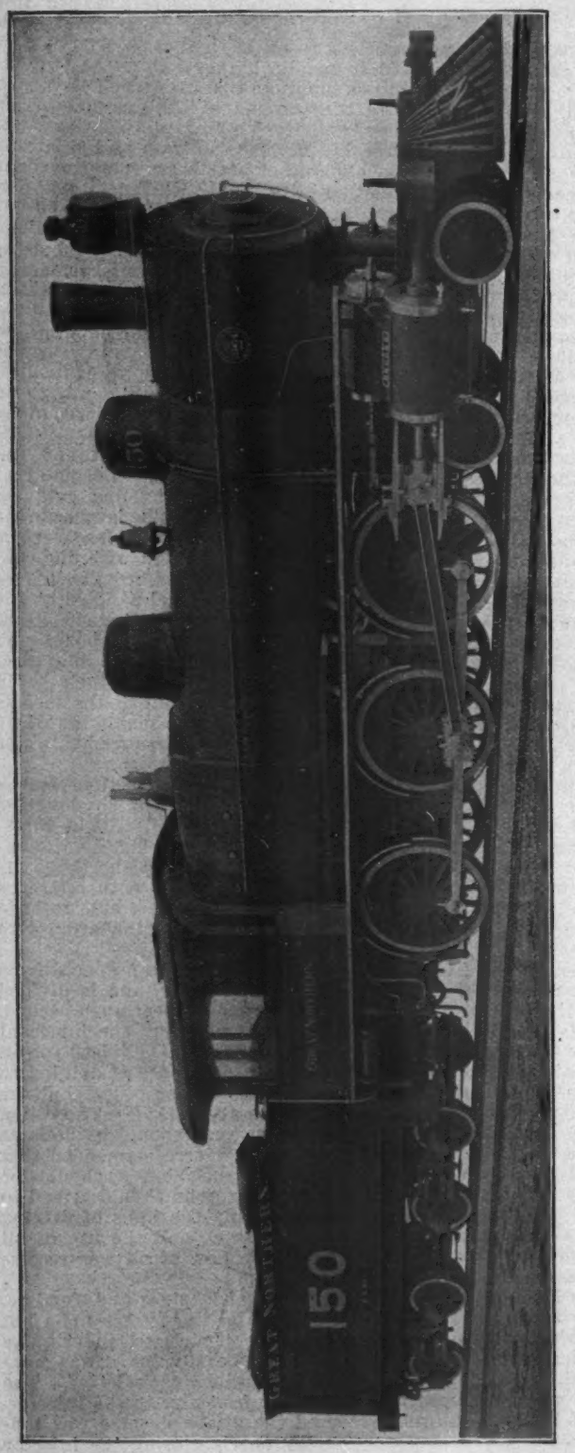
The Use of Water on Hot Bearings of Engines and Tenders.—The majority favored the use of water in streams upon hot journals, and it was quite customary to fit pipes to tender tanks in order to reach the tender truck boxes easily, but it was more difficult to reach the driving and engine truck boxes. The water was sometimes taken from the feed pipe to the injector, and if lifting injectors were used the discharge pipe was tapped. This gave hot water, but by nearly closing the injector down the temperature might be reduced to about 90 degrees.

The cost of extra fuel required to light a train of ten cars by an English system of dynamos driven from the axles of the cars at ordinary speeds is one-half pound per train mile, according to the "Railroad Gazette."

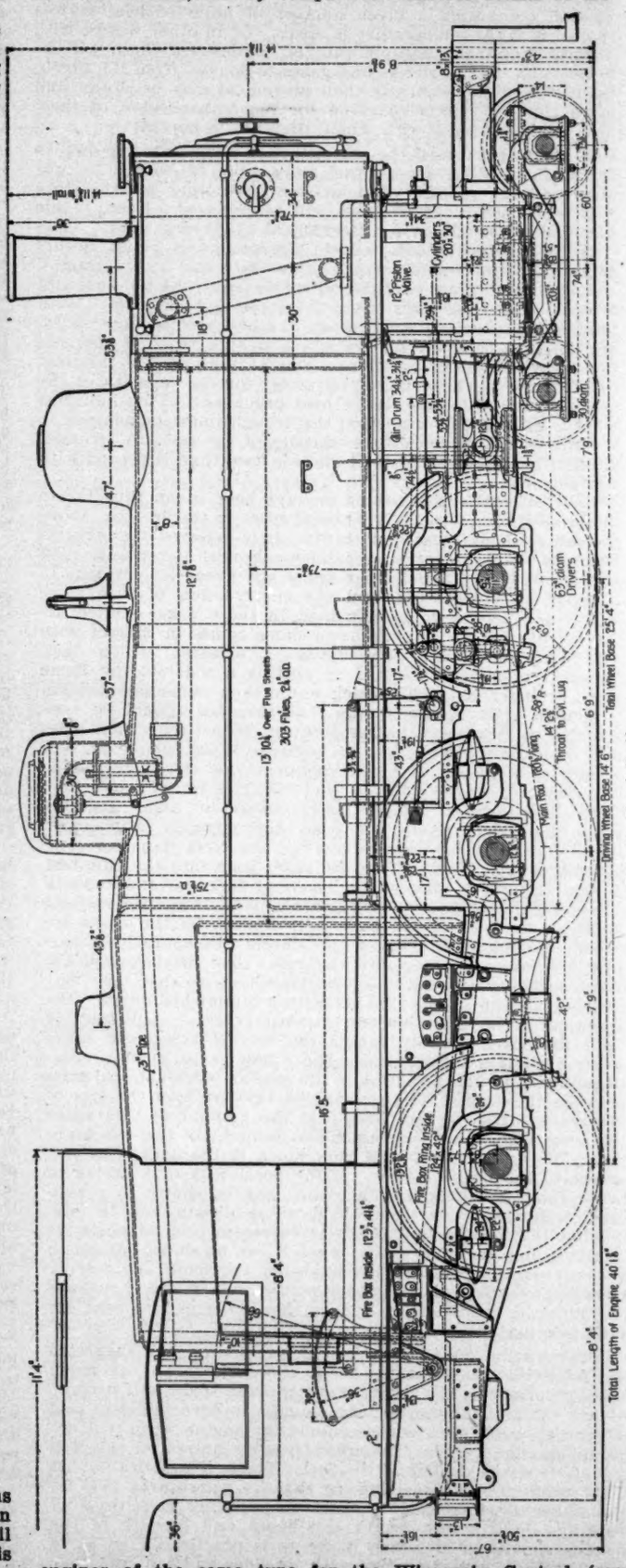
TEN-WHEEL PASSENGER LOCOMOTIVES—GREAT NORTHERN RAILWAY.

The recent improvement of the locomotive equipment on the Great Northern Railway includes a new design of very heavy passenger locomotives built by the Brooks Locomotive Works, of Dunkirk, N. Y. Eight of these engines have been in service for four months, and they are reported to be giving very satisfactory results. They are the heaviest passenger locomotives ever built and a comparison with the dimensions and weight of the engines of the same type of the Southern Railway, illustrated in our issue of March 1898, page 82, will be interesting. The total weight of the Southern engine is 158,000 pounds, and the weight on drivers is 121,250 pounds, while the corresponding weights of the Great Northern design are 166,000 pounds and 129,500 pounds.

The cylinders are 20 inches in diameter by 30 inches stroke, these dimensions and the weight being in accordance with the ideas of Mr. J. J. Hill, President of the road. In general, the details are in accordance with the practice of these builders, and by comparison with the details of the engines of the same type for the Wisconsin Central (see "American Engineer," June, 1898, pp. 190-193), a similarity in general details will be found, except that the Wisconsin Central engines are much lighter, the total weight being 150,000



From a Photograph.



Longitudinal Section.

Ten-Wheel Passenger Locomotive—Great Northern Railway.

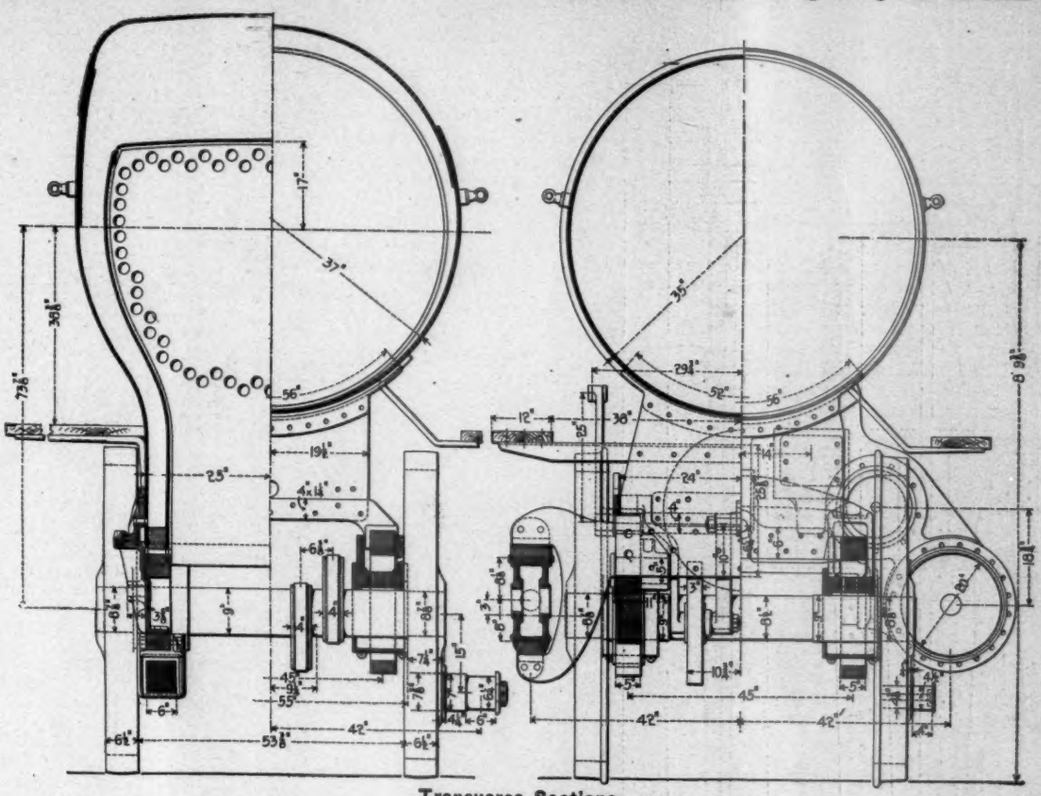
Brooks Locomotive Works, *Builders.*

J. O. Pattee, *Superintendent Motive Power.*

pounds and the weight on drivers 116,000 pounds. The Wisconsin Central engines exert a draw-bar pull of 30,000 pounds, and the Great Northern engines give a maximum pull of 36,000 pounds. These figures are given by the builders. The draw-bar pull at 66 per cent. cut-off is given at 32,500 pounds. These figures give co-efficients of adhesion of 3.6 and 3.9, respectively.

The driving wheels are 63 inches in diameter, which, with the long stroke, will give high piston speeds. The boiler is large, the diameter of the first course is 70 in., and the heating surface is 2,677 square feet, of which 225 square feet is in the firebox and the arch tubes. This is the largest heating surface used in passenger service, but it will all be needed for these large cylinders, and we wonder whether the results will justify the employment of single expansion cylinders. The steam pressure is 210 lbs., and this makes it evident that the object was to obtain as great a ratio of expansion as possible without using the compound principle. The grate area is 35.4 square feet and the firebox, which is on top of the frames and slopes downward toward the front, is 123 in. long and 41¼ in. wide. Its depth is 80 in. in front and 62 in. at the back. The water spaces are given in the table and it will be noticed that they begin to enlarge below the point of curvature in the side sheets. The horizontal seams are sextuple riveted with lap joints, the object being to lighten the seam and make it more flexible than the butt joint. All the shell seams except those for the back head and the front flue sheet are triple riveted with 1⅛ in. rivets at 3¾ in. pitch. The firebox flue sheet is ⅝ in. thick and the front one is ¾ in. thick. Bell's spark arrester and short front end, which has been used in a number of large Brooks engines is employed and it is giving excellent results, both as a spark arrester and in free steaming.

The arrangement of the cylinders and piston valves is the



Transverse Sections.

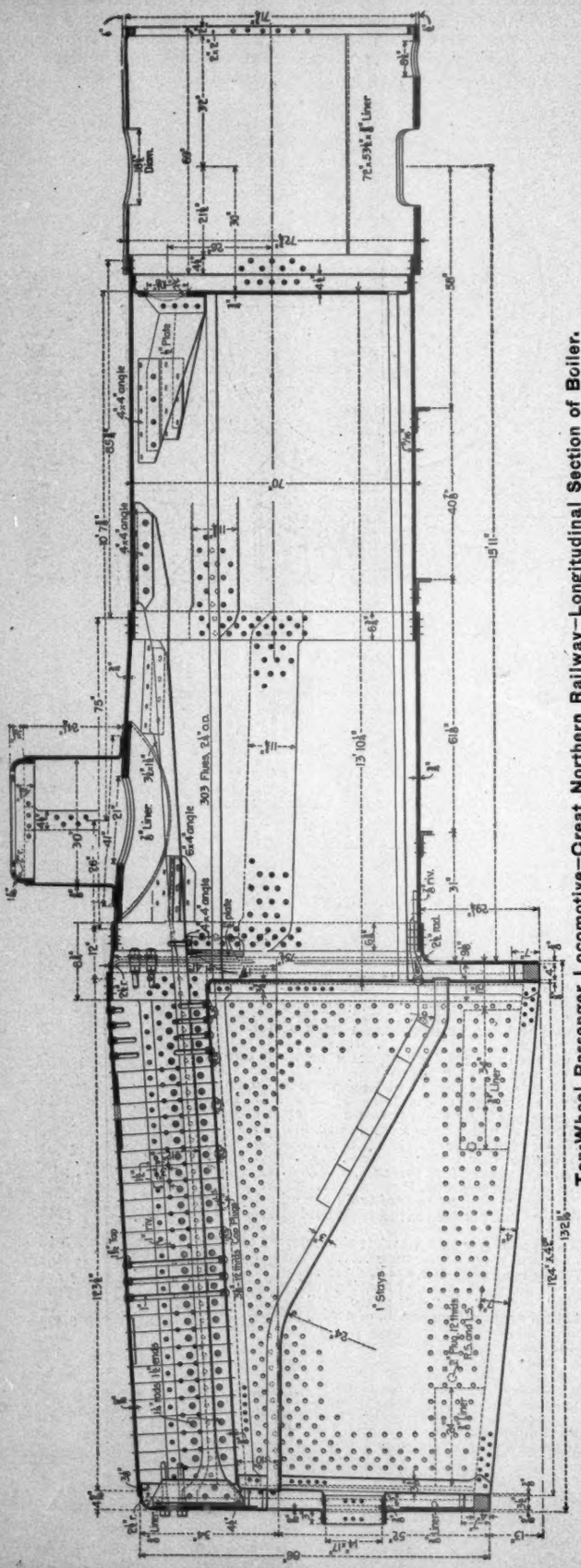
GENERAL LOG OF RESULTS.

LOCOMOTIVE TESTS ON THE GREAT NORTHERN RAILWAY BETWEEN CLANCY AND WOODVILLE.

	Pass.	Freight.
Engine, No	154	154
Date of trial	7-28-98	7-29-98
Length of run, miles	48.1	48.1
Kind of service, freight or passenger	P	F
Weather	Fine.	Fine.
Mean temperature of the atmosphere	76°	85°
Wind	Very Light.	Very Light.
Condition of rail	Good.	Good.
Size of exhaust nozzle, single	5¾ in.	5¾ in.
Time on the road	2 h. 17 m.	4 h. 35 m.
Actual time in motion	1 h. 50 m.	3 h. 34 m.
Aggregate intermediate stops, minutes	27	61
Time during which power was developed	1 h. 34 m.	3 h. 10 m.
Maximum speed, miles per hour	40.5	33.8
Average " " "	26.2	13.5
Maximum revolutions per minute	264	180
Maximum piston speed, feet per minute	1,320	900
Minimum seconds per mile	72.9	106
Maximum boiler pressure	210	210
Minimum " "	175	165
Average " "	196.4	198
Prevailing position of throttle-lift	0.5 ins.	0.5 ins.
" throttle opening, square inches	16.6	16.6
" position of the reverse lever	7 & 10	7, 10 & 18
" cut-off, inches	7 in. & 10 in.	7 in., 10 in. & 18 in.
" " per cent. stroke	23 & 33	23, 33 & 60
Weight of train in tons of 2,000 lbs., inclusive of locomotive and tender	289	549
Wt. of train, excl. of loco. and tender, tons	157	417
" " " " tender & way car, tons	....	410
No. of cars	5	11
" " loads		10
Total weight of coal consumed, lbs.	7,300	11,000

	Pass.	Freight.
Engine No.	154	154
Number of miles per ton of coal	13.2	8.3
Lbs. of coal used per hour	152	241
Coal used per 100 tons of train per mile	52.7	44.0
Coal used per 100 tons of train back of tender per mile	96.8	57 9
Coal used per 100 tons of train between tender and way car, per mile	.....	58.9
Weight of coal burned while throttle was open	7,050 lbs.	11,300 lbs.
Average weight of coal burned per sq. ft. of grate per hour while throttle was open	127 lbs.	101 lbs.
Weight of water drawn from tank, lbs.	35,000	50,000
Waste of injector	225	240
Weight of feed water	34,775	50,360
Temperature of feed water	56°	56°
Water used per mile, lbs	724 lbs.	1,235 lbs.
" " " 100 tons of train per mile	251 lbs.	225 lbs.
Water used per 100 tons of train behind tender per mile	461 lbs.	296 lbs.
Water used per 100 tons of train between tender and way car per mile	.....	301 lbs.
Water used per hour, lbs	22,160 lbs.	18,750 lbs.
" " " sq. ft. of heating surf. per hour	8.28 lbs.	7.01 lbs.
" " " " " grate " " "	626 lbs.	529 lbs.
Actual evaporation per lb. of coal	4.93 lbs.	5.27 lbs.
Equivalent " from and at 212° per lb. coal	6.00 lbs.	6.40 lbs.
Maximum I. H. P. developed	1,468	1,116
Average "	922	839
Coal per I. H. P. per hour, lbs.	4.87	4.26
Water per I. H. P. per hour, lbs.	24	22.4
Average No. of sq. ft. of heat. surf. per I. H. P.	2.9	3.19
Average No. of I. H. P. per sq. ft. of grate surf.	26 1	23.6
Maximum grade, feet per mile	116	116
Average rise, feet per mile	64.7	64.7

same as in the Wisconsin Central engines except that the Great Northern engines have extended piston rods. The frames of the engine are 5 in. wide except at the front and back ends, where they were formed into slabs; at the cylinders they are

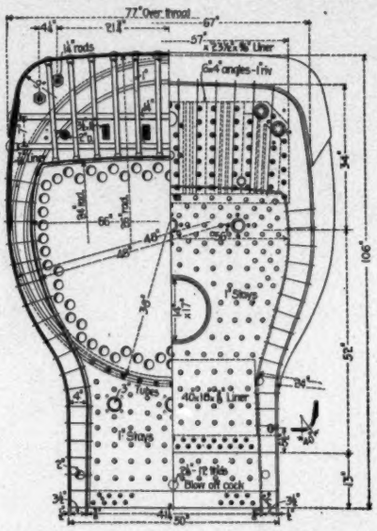


Ten-Wheel Passenger Locomotive—Great Northern Railway—Longitudinal Section of Boiler.

3½ by 10 in. section. The front ends are connected by a heavy 18 in. channel and the back ends by two lighter channels of the same height, with a ⅝ in. vertical plate between them. This forms the support for the cab deck and running boards. The running boards, engine decks and tender deck are on one level. The tender has a capacity for 4,500 gallons of water and 8 tons of coal, together weighing 96,000 lbs.

The spring rigging is similar to that of the Wisconsin Central engines (see American Engineer, 1898, p. 190) with the front driving wheels equalized across the engine by means of a heavy leaf spring. The main equalizers are in the form of 42 in. leaf springs, and the outer ends of the driving box levers bear on 22 in. elliptic springs. The driver brake shoes bear against the rear of the wheels and the cylinders are inside the frames, just in front of the rocker boxes. The injectors and checks are inside the cab.

The indicator cards are reproduced because of the interest in piston valves. They were taken in tests of one of the engines in freight and passenger service and the data reproduced here were taken by the builders. We would like to compare these figures with results obtained upon a stationary testing plant, but this cannot be done, and as our readers may like to see the results of road tests they are given the opportunity.



Transverse Sections of Boiler.

We do not take much stock in road tests, however, for comparisons. The cab log shows the minimum steam pressure to be 165 lbs. in freight and 175 lbs. in passenger service, and the average pressures were 198 and 196.4, respectively. The trains were light but the grades averaged 64.7 feet per mile for the 48 miles. The water per horse power is given at 24 lbs. for passenger service and 22.4 for freight. It is worth noting that the record is much better in freight than in passenger service. The indicator cards were taken with the other records, at each mile post, the left side of the engine being indicated with a 120 lb. spring for passenger service, and the right side with a 150 lb. spring for freight. The chief dimensions of the engine follow:

DESCRIPTION.

Type	ten-wheel passenger
Gauge	4 feet 8½ inches
Kind of fuel	Bituminous coal
Weight on drivers	129,500 pounds
" on trucks	36,500 pounds
" total	166,000 pounds
" tender loaded	96,000 pounds
Wheel base, total, of engine	25 feet 4 inches
" " driving	14 feet 6 inches
" " total, engine and tender	53 feet 7½ inches
Length over all, engine	40 feet 1⅝ inches
" " " total, engine and tender	62 feet 2⅜ inches
Height, center of boiler above rails	8 feet 9⅜ inches
" of stack above rails	14 feet 11¼ inches
Heating surface, firebox and arch pipes	225 square feet
" " tubes	2,452 square feet
" " total	2,677 square feet
Grate area	35.4 square feet
Wheels and Journals.	
Drivers, number	6
" diameter	63 inches
" material of centers	Cast steel
Truck wheels, diameter	30 inches
Journals, driving axle, main	9 by 11 inches
" driving axle, front and back	9 by 11 inches
" truck	5½ by 12 inches
Main crank pin, size	6¼ by 6 inches
Cylinders.	
Cylinders, diameter	20 inches
Piston, stroke	30 inches
Piston rod, diameter	4 inches
Main rod, length, center to center	120½ inches
Steam ports, length	18 inches
" " width	2 inches
Exhaust ports, length	56 inches
" " least area	66.5 square inches
Bridge, width	2½ inches

Valves.

Valves, kinds of	improved piston
" greatest tavel	7 inches
" steam lap (inside)	1⅛ inches
" exhaust lap or clearance (outside)	⅛ inch
Lead in full gear	1-16 inch negative
" constant or variable	Variable

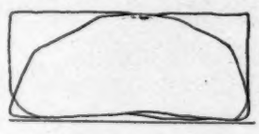
Boiler.

Boiler, type of	Player improved Belpaire
" working steam pressure	210 pounds
" material in barrel	Steel
" thickness in barrel	11-16 inches
" " " tube sheet	¾ inch
" diameter of barrel	70 inches
Seams, kind of horizontal	Sextuple
" " " circumferential	Double and triple
Crown sheet, stayed with	Direct stays
Dome, diameter	30 inches

Firebox.

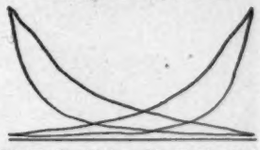
Firebox, type	Long, sloping
" length	123 inches
" width	41¼ inches
" depth front	80 inches
" " back	62 inches
" material	Steel
" thickness of sheets: crown, ⅜ inch; tube, ⅝ inch; side and back, ⅜ inch	
" brick arch	On water tubes
" mud ring width, back, 3½ inches; sides, 3½ inches; front, 4 inches	
" water space at top, back, 4½ inches; sides, 6 inches; front, 4 inches	

Speed, 9 M. P. H.
Boiler pressure, 200 lbs.



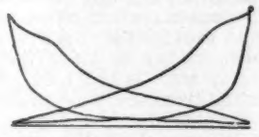
M. E. P., 171.5. M. E. P., 165.
I. H. P., 188.

Speed, 48 M. P. H.
Boiler pressure, 195 lbs.



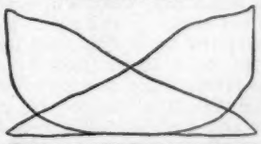
M. E. P., 33.6. M. E. P., 30.3.
I. H. P., 196. I. H. P., 184.

Speed. 27 M. P. H.
Pressure, 200 lbs.



M. E. P., 55.1. M. E. P., 59.1.
I. H. P., 182. I. H. P., 202.

Speed, 34 M. P. H.
Pressure, 205 lbs



M. E. P., 88.8. M. E. P., 90.
I. H. P., 367. I. H. P., 386.

Indicator Cards.

Grates, kind of	Cast iron, rocking
Tubes, number of	303
" material	Charcoal iron
" outside diameter	2¼ inches
" thickness	No. 11 B. W. G.
" Length over tube sheets	13 feet 10¼ inches

Smokebox.

Smokebox, diameter outside	72¾ inches
" length from flue sheet	64 inches

Other Parts.

Exhaust nozzle, single or double	Single
" " variable or permanent	Permanent
" " diameter	5 inches, 5 3-16 inches, 5⅝ inches
" " distance of tip below center of boiler	1 inch
Netting, wire or plate	Wire
" size of mesh or perforation	2½ by 2½ and 2⅛ by 1¼
Stack, straight or taper	Steel taper
" least diameter	15⅞ inches
" greatest diameter	18⅞ inches
" height above smokebox	38 inches

Tender.

Type	Eight-wheel, steel frame
Tank, capacity for water	4,500 gallons
" " " coal	8 tons
Type of under frame	Steel channel
Diameter of wheels	33 inches
" and length of journals	4¼ by 8 inches
Distance between centers of journals	4 feet 10 inches
Diameter of wheel fit on axle	5⅝ inches
" " center of axle	4⅞ inches
Length of tender over bumper beam	21 feet 4 inches
" " tank	19 feet 6 inches
Width of tank	8 feet 8 inches
Height of tank, not including collar	55 inches
Type of draw gear	M. C. B. standard

Special Equipment.

Brakes	N. Y. automatic for drivers, tender and train service
Pump	No. 2, New York
Sight feed lubricators	Nathan
Safety valves	Crosby
Injectors	New Nathan No. 10 and Monitor No. 10
Springs	A. French Spring Co.

The Young Men's Christian Association, at its West Side Branch, 318 West 57th street, New York, opens an evening school Oct. 3 for young men who are engaged in business during the day. Its rooms are well equipped, and the usual courses of instruction, including mechanical drawing, have been provided. Information may be had from the Secretary at the address given above.

THE CONSTRUCTION OF A MODERN LOCOMOTIVE.*

By T. R. Browne.

V.

MACHINE SHOP.

The amount and kind of equipment necessary in this department, its relation to the maintenance of the equipment in other departments, as well as its relation to the character of its finished product, considered from the standpoint of quantity, interchangeability and cost, renders the machine shop one of the most important departments of the whole plant. For the amount of floor space usually covered the total investment in equipment is very much greater than any of the other departments in the construction of locomotives, and not only the

Fig. 1.

equipment, but the organization and character of supervision in connection with the equipment must be of the highest order to secure the best results and the proper earnings per square foot of surface inclosed and occupied by and per dollar invested in equipment.

Tool Department.—For the purpose of keeping in repair all of the facilities and equipment throughout the plant, not only in the interest of lowest cost, but in order that the repairs may be made in the most intelligent and expeditious manner, it has been found advisable to include in the organization of this shop a department known as a tool department, in charge of a competent foreman, who is responsible for all of the tools and equipment used in production throughout the plant. If convenient, in each one of the other departments a mechanic is

Fig. 2.

located who reports directly to the foreman of the tool department and represents that department in the shop in which he is placed.

The frequent and intelligent inspection, followed by prompt repairs of all the equipment throughout the plant by this department, leaves only for the foremen of the various departments in which the equipment is placed the supervision of their equipment incidental to the production of the greatest amount of output. It will also have a tendency to improve the character and standardize the class of repairs made to tools and machinery at a very much less expense than would be the case were these repairs governed by the judgment of the different

* For previous article, see page 187.

foremen of departments in which this equipment is operated. It is assumed—and not without good reason—that the supervision of the men employed and the operation of the facilities in his department to the best advantage will employ the entire time of the foreman of that department, and to much better advantage, everything considered, than would be the case were he expected also to keep his equipment in perfect repair. It is necessary at times that the tool department should consist of a very much larger force than that necessary to operate the machines in the manufacture of small tools. This additional force required for ordinary and extraordinary repairs in the various departments is provided by those departments in which the work is to be done, the men for the time being working

Fig. 3.

under orders of the foreman of the tool department. All of the time and material used in repairs to facilities in the various departments is charged to the annual work orders issued to these departments and referred to in earlier articles. The large variety of small tools of peculiar nature which cannot be purchased, together with jigs, fixtures, gauges, etc., required in the production of duplicate parts of a locomotive, are also made in the tool department, which also has charge of the various tool rooms throughout the plant, keeping a record of tools broken by carelessness or otherwise and making regular reports to the office of the superintendent.

In addition to the tool department there should be included in the organization of the machine shop certain subdivisions

Fig. 5.

or sub-departments, known as a wheel and axle department, brass department and vise department.

With the exception mentioned in a previous article on the blacksmith shop all of the machine work necessary for finishing the parts used in the construction of a locomotive to exact sizes should be concentrated where the majority of that character of facilities exist, and the advantages of concentrating as much as possible the various kinds of machinery used for this purpose will be apparent. This being the case, with the exception of the boiler, the machine department will furnish to the erecting shop all of the parts necessary for the complete erection of the engine, of course not including the wood work and work of a similar character, the metal parts for which will be furnished to the department in which this work is done by the machine shop.

Laying Out Work.—A general introduction of piece work necessitates a careful inspection of output and the variety and size of parts, the frequent lining off or laying out of such portions as are to be machined. The most economical arrangement of labor provides in most cases a class of men operating

Fig. 4.

the machines, who, while good operators, are not sufficiently skilled either in the reading of drawings or laying off of their own work to be depended on, and to provide for this division of the work an additional department, known as the laying off department, and in charge of a leading man, is provided. The force which he will require is recruited from the most progressive and best educated men of the shop, who act as inspectors, not only of the material delivered from other shops to the machine shop, but of the finished product from this shop.

A complete system of solid gauges, both for inside and outside measurement, is provided, and to these gauges all of the parts on which they are to be used are finished. They prac-

Fig. 6.

tically cover all of the operations comprised in milling, slotting, planing, etc., and are subject to frequent check with master gauges kept in the tool department. Sheet iron templates are provided for the marking off of holes for drilling where the parts are of such size or shape as to interfere with the use of regular drilling jigs. In the case of cylinders, saddles, etc., cast iron drilling jigs are provided, which are bolted to the casting and not removed until all of the holes indicated in the jigs are drilled. It is usually sufficient in jigs of this character to provide not more than two bushings, which can be removed and inserted in succeeding holes in the jigs during the operation of drilling. Jigs of this kind are provided for drill-

SCHEDULES FOR LOCOMOTIVE WORK.

Schedule "A," Boiler and Mountings.

1.

The boiler, with flues, washout plugs or flanged connections for washing out, and provided with all such holes or connections as can be made in the boiler shop expeditiously, and such parts rivetted on at that point, and furnished to the erecting shop ready for the mounting.
Hopper box.
Side caps.
Dry pipe braces.
Checks.
Washouts.
Tee head studs.
Dry pipe sleeves and bolts.
Dry pipe hangers and bolts.
Tee heads and joints.
Throttle valve.
Throttle valve chamber and bolts.
Upright steam pipe and bolts.
Dome sheets.
Front tube sheets.
Mud ring—braces and bolts.
Smoke box ring and union ring for smoke box, and union ring for smoke box to boiler.
Sand box base.
Sand box top.
Fire box doors and frames.
Fire box door forgings.

2.

Sand boxes complete.
Bells and yokes.
Throttle rod ends and stuffing boxes.
Supplemental dome.
Cab saddle.
Bridge pipe and flanges, also valve.
Lubricator stand and base.
Engineer's brake valve stand and base.
Steam gauge stand and base.
Injector pipe brackets.
Stack base.
Stack base ring and top.
Headlight brackets.

3.

Cocks and valves.
Supplemental dome cap and casing.
Main dome cap and joints.
Hip castings.
Air brake brackets.
Steam pipes, with joints.
Exhaust boxes.
Jacket angle irons.
Netting angle irons.
Front end for smoke box and door.
Hand rail columns and bases.
Exhaust nozzles.
Shaking grates.
Damper rigging forgings.
Whistle and connections.
Injectors and pipes.
Engineer's brake valve.
Signal lamp brackets.
Drip pan.
Waste pipe clamps.
Air pump air reservoirs.
Badge plates.

Schedule "B," Frame Work.

1.

All bolts and studs used in frame work.
Main frames.
Cylinders.
Front end frames.
Bumper castings.
Smoke box braces.
Pedestal caps.
Pedestal bolts.
Driver brake brackets.
Frame stiffening pieces.
Equalizer posts.
Foot plates and bushings.
Cab brackets.
Engine steps.
Cross pedestal braces.
Frame braces.
Spring hangers.
Driver brake fulcrums.
Buffer castings and springs.
Back cylinder heads.
Guide yoke and knees.
Rockers and rocker boxes.
Lift shaft and bearings.
Guides.
Guide bolts.

2.

Steam chests and casings.
Steam chest lids.
Front cylinder heads.
Front cylinder head casings.
Pressure plates.
All spring rigging not included in No. 1.

3.

Schedule "C," Wheel Work and Engine Trucks.

1.

Driving boxes, with cellars, keys, bushings, etc.

2.

Driving wheel centers.
Driving axles.
Keys for driving axles.
Crank pins.
Dowel screws for crank pin washers.
Crank pin washers.
Truck frames.
Truck pedestals.
Truck centers.
Truck spring seats.
Truck braces.
Truck springs.
Truck spring hangers, with thimbles and bolts.
Truck spiders.
Truck boxes, with cellars, keys and brasses.
Wheels and axles.
Truck brake complete.
Sponging in truck boxes.

Schedule "D," Tank and Tender Work.

1.

Tanks and tender frames, including flooring, couplers and connection, painted.
Tender trucks complete.

2.

To include all water scoop, steam heat, air brake and signal work.
Draft irons.

Schedule "E," General Erection and Completion of Engine.

1.

Boiler, as per schedule "A."
Frames, as per schedule "B."
All bolts, studs and nuts.
Pads.
Running board brackets.
Side irons.
Cab brackets.

2.

Links and hangers.
Boiler tested.
Lagging or boiler covering put on.

3.

Cab.
Wheels put under engine.
Spring rigging connected.
Valve rod and eccentric rods.
Foot plates and running boards.
Jacket finished.
Dome casing put on.
Pipes, air and driver brake, connected.
Pistons put in.
Main rods fitted.
Engine generally finished and inspected, previous to going to paint shop.

Schedule "F," Final Test and Inspection of Engine.

1.

Engine returned to erecting shop from paint shop.
Side rods put on.
Headlight.
Tender to engine.
Tank hose and tank cock.

2.

Engine steamed up.
All air and injector pipes tested.
Air pipes blown out.
Generally inspected.
Sent up for test.

ing the holes for cylinder head and steam chest studs, and the one for cylinder head studs so arranged as to answer for the cylinder heads. In the case of the back cylinder head, the jig is located with reference to a center line, and holes are provided in it for drilling the holes for guide bolts. This same center line is used in erecting, and it will be obvious that holes drilled in this way will do away with the necessity of specially hanging the guides. A jig is used on the guide yoke, which is adjustable for the back end bolt holes, and the operation for hanging the guides is not only simplified, but reduced in cost when it comes to a point of erection. The accuracy attainable in the construction of a boiler, due to the system of lining and fitting up, described in a previous article, permits of almost final machining of the cylinder saddles where they fit the front end or extension. An auxiliary bar made to a radius equal to the radius of the front end and carrying a tool head, will permit of planing these saddles to the required shape, and save the time usually taken by chipping. The center marks can be made on this bar corresponding to the center marks on the cylinder, and made at a point located with reference to the frame fits and saddle joint, giving most accurate results in finished cylinders.

Schedule of Parts.—In an earlier article reference was made to a schedule of the various parts required and the order in which they were to be gotten out by the various departments throughout the works. A copy of this schedule is given below. This schedule is not intended to cover with the greatest accuracy all the parts that are required, but only sufficiently to provide a general guide for the various departments in which either a part or whole of these parts may be prepared. It has been found that the smaller details, which may be omitted, are generally of such a nature as to be finished in ample time for general erection.

Schedule for Turning Out Standard Locomotive Work.

The various schedules and subdivisions of material or parts for locomotives shall be designated by the letters "A," "B," "C," "D," "E" and "F." Those parts under the division numbers shall be turned out in the order in which they are numbered; that is to say, No. 1, Schedule "A," signifies that all of the parts numbered "1" are to be turned out first on the schedule. This explanation of one instance answers for all similar cases in the following schedules. These numbers refer to the connection that these parts have with the expeditious completion of the engines, working under the best advantage.

The order in which these parts are required is in accordance with the methods of erection followed in the erecting department, because all of the departments throughout the works are contributive to that department, and work in accordance with its demands.

The various processes through which the parts required in a modern locomotive have to pass in the machine shop are sufficiently familiar to make unnecessary any detailed description, with possibly the exception of a few cases, which are exceptions to ordinary practice.

In the wheel and axle department all of the operations necessary to prepare the wheels for placing under the engine are conducted. Figs. 1, 2, 3 and 4 illustrate the method of heating with crude oil for the purpose of expanding the tires, pre-

paratory to putting them on the centers; Fig. 1 showing a pair of tires during the process of heating, Fig. 2 the temporary removal of the top tire until the center can be dropped in as illustrated in Fig. 3, when the tire shown in Fig. 2 is put in place, as illustrated in Fig. 4. The device shown is caused to rotate by hand or motor, the furnace remaining stationary, but adjustable for different diameters of tires.

With the introduction of bronze hub liners, cast directly on the wheel, it became necessary to adopt a simple and efficient method of doing this work in the shop. Figs. 5 and 6 illustrate a small furnace operated with oil and used for this purpose, the bronze being melted in the crucible and the crucible, as shown in Fig. 6, used as a pouring ladle.

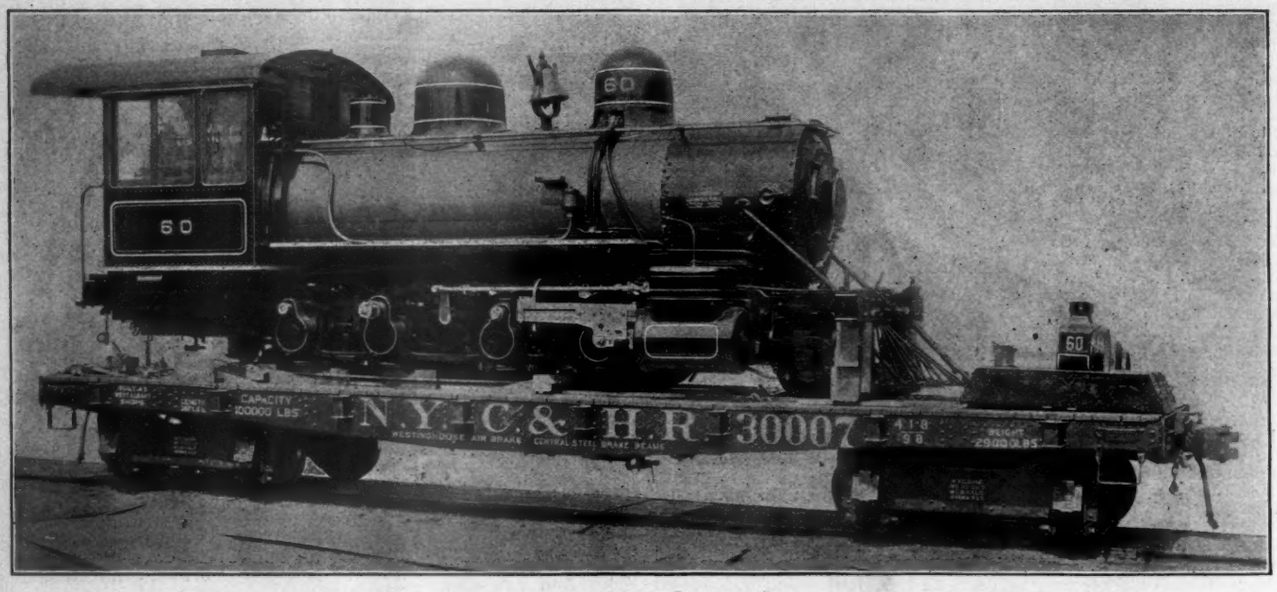
All of the pin fits are bored to solid gauge and the pins turned to a solid gauge, allowance for tonnage being made in the gauges. These gauges are made hollow, and have wooden handles to prevent excessive expansion.

A complete equipment of turret machinery with the box form of tools arranged for standard forms of brass work will produce parts of this character at the lowest cost and in largest quantities. These tools are arranged with reference to a succession of operations, each tool is numbered, and they are adjusted in the machine for a given kind of work by a skilled mechanic. The operator of the machine is not necessarily a mechanic, and, in fact, a man of quite ordinary attainments becomes exceedingly skillful in a short space of time on this class of work.

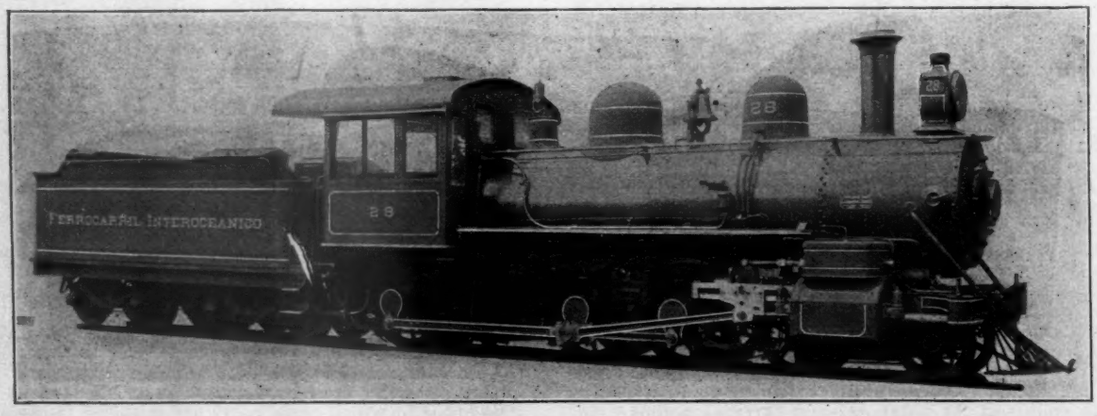
The use of carefully made dies for forming, by hydraulic pressure, the various smaller types of forgings required, will very materially reduce the amount of machine work and finishing necessary in the machine shop. In fact nearly, if not all, of the forgings of a smaller type which require finish, either for running fit or for the purpose of showing up any defects which may exist, can be made so close to size that an operation of grinding will be all of the finish required.

It has been found thoroughly practicable to produce in all of the parts having any connection with the link or valve motion a finish sufficiently accurate to not only make these parts thoroughly interchangeable, but the operation of actually setting the valves on the locomotive in its final erection unnecessary. In connection especially with the parts used in the link and valve motion, a system of mechanical inspection is provided for by a set of jigs for each operation, and so arranged that a previous operation, if not exactly correct, will prevent the part in question being placed in the jig used for the next succeeding operation. It will be obvious that with the links, bridles, hanger rods, eccentric and various other vital parts of the link motion prepared in this way, there is no reason why not only these parts should interchange on various engines of the same type and size, but that if this degree of accuracy is carried out through the other parts having any connection with the link motion, the results will be accurate in the extreme.

In the case of eccentrics, the keyways are cut after the eccentrics are bored, the eccentric mounted on a mandrel having a corresponding keyway, and the mandrel set at the proper degree of advance; or, in other words, a mandrel or jig practically takes the place of the axle with the exception that its center is the center of the eccentric. The outside portions of the eccentric are finished while it is mounted on this mandrel. A center punch mark is made in the eccentric by a punch located in this mandrel at the proper point, indicating a position of full forward when the eccentric shall have been placed on the axle. The operation of clamping the eccentric on the mandrel causes the punch to make the mark. In the process of erection a tram is used, one end resting in this center punch mark and



Narrow Gauge Locomotive for Interoceanic Railway of Mexico, Shipped on Fox Steel Car



Ten-Wheel Schenectady Compound Locomotive—Interoceanic Railway of Mexico.

the other in the center of the eccentric rod jaw pin, thus providing for the accurate setting of the eccentric rod. The keyways in the axle for eccentrics are located in the same position, namely, on a center line through the axle and pin fit on all classes of engines, any change in the angle of advance being made in the eccentrics themselves. This provides that these keyways can be milled before the axles are mounted in the centers, and not only provides an exceedingly accurate method of location, but saves the time usually taken by the old method of drilling and chipping these keyways after their location has been found and when the wheels are under the engine.

A complete overhead track system with pneumatic hoists in this department, as well as throughout the whole shop, provides an easy and convenient method of handling the various smaller parts which are not handled by the large crane, as well as largely reducing the fixed charges for labor.

JOHN M. TOUCEY.

John M. Toucey, formerly General Manager of the New York Central & Hudson River Railroad, died at his home at Garrison's, New York, Sept. 23, after an illness of several months. He leaves a widow and one son. For about a year his health had been poor, and when he retired from the management of the road, last May, he became rapidly worse, and in spite of all efforts and changes of climate he gradually failed. He began his railroad work at the age of 20 years, in 1848, and never left it until last May. His first position was station agent on the Naugatuck Railroad. He went to the New York Central in 1855, and in 1862 was appointed Assistant Superintendent. From 1867 to 1881 he was Superintendent of the Hudson River Division, and from 1881 to 1890 he was General Superintendent, becoming General Manager of the whole road in 1890. A number of changes were made when Mr. S. R. Callaway took the Presidency last Spring, the position of General Manager being abolished, and Mr. Toucey was made Assistant to the President. He resigned this position and was honored by a pension. Mr. Chauncey M. Depew pays the following tribute to Mr. Toucey:

"Mr. Toucey was with the New York Central for over forty years. He began as a conductor and advanced step by step to the post of General Manager. For the last thirty years I knew him intimately. I always regarded him as one of the ablest railway operators in the country. In the field of managing trains he had few if any equals. He had in particular the gift of moving traffic and passengers with great expeditiousness on time and with a maximum good for the company at a minimum cost. His record was extraordinary, in that with the immense amount of traffic that he handled, he met with so few accidents. He was loyal to a fault, and simple-minded in his honesty. His dominant trait was fidelity—fidelity to his friends and to his company. He had a host of friends and was well known to railroad men all over the world."

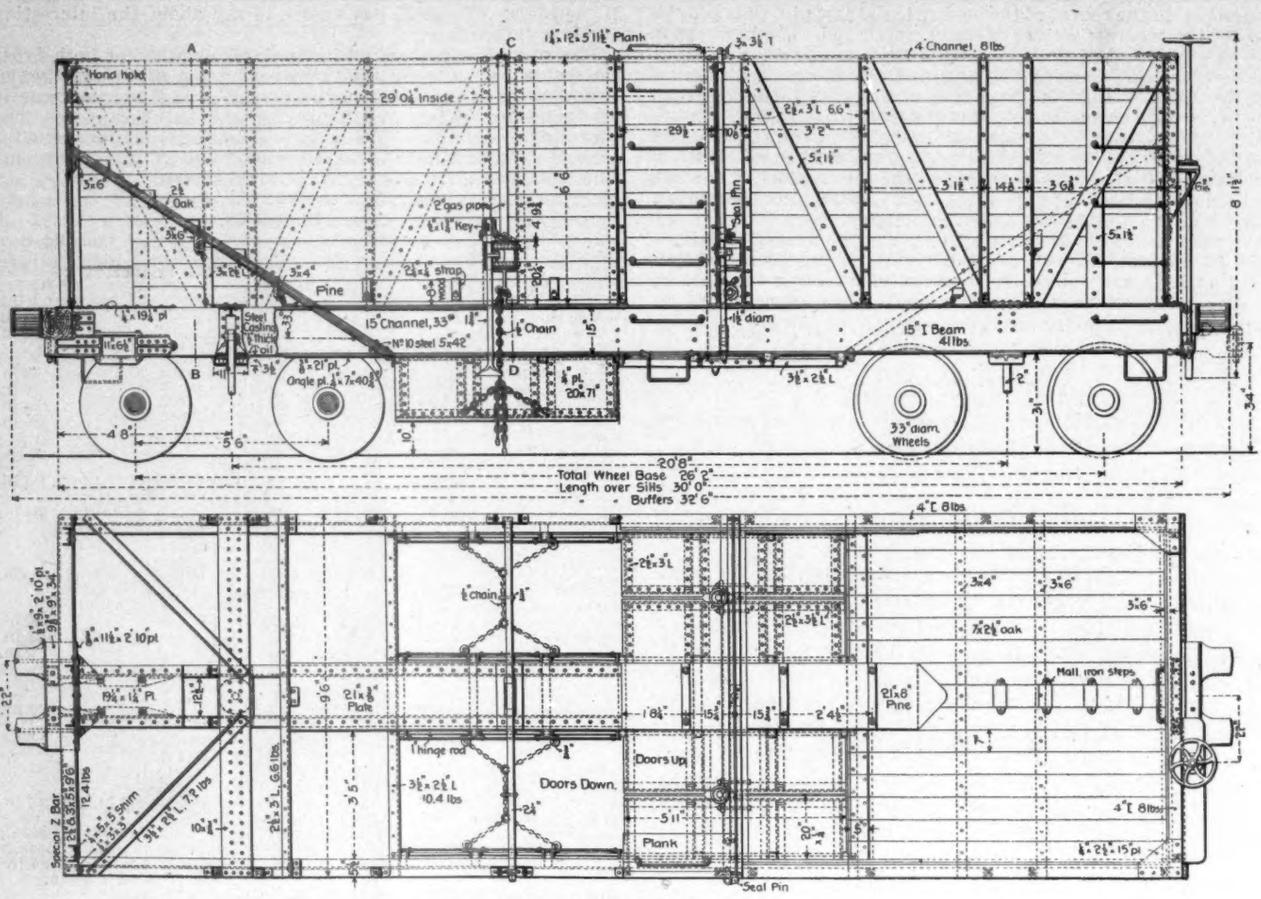
NARROW GAUGE LOCOMOTIVES—INTEROCEANIC RAILWAY, MEXICO.

Through the courtesy of the Schenectady Locomotive Works, we have received photographs and particulars of two designs of narrow-gauge locomotives built by them for the Interoceanic Railway of Mexico. Two of the ten-wheel compounds and six of the simple consolidations have been built in accordance with specifications arranged in consultation with Mr. Henry E. Walker, Locomotive and Car Superintendent of the road. The consolidations are in service, and very favorable reports of their operation have been made. They have straight boilers and the fuel is coal briquettes. The cranks are outside of the frames, while the driving wheels, owing to the narrow gauge of 3 feet, are inside, the driving boxes being faced with bronze on both bearing surfaces.

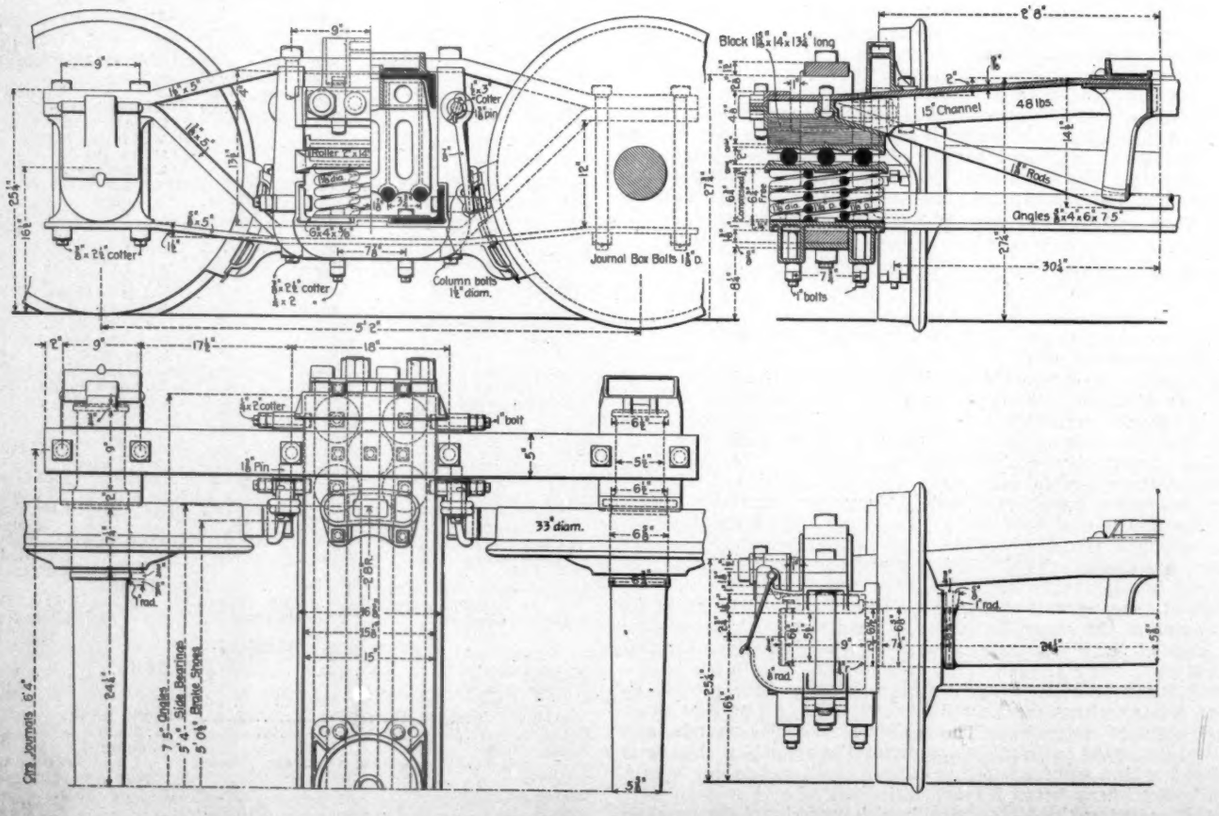
One of the engravings shows the novel method of shipping an engine of the consolidation type upon one of the new steel flat cars of 100,000 pounds capacity of the New York Central & Hudson River Railroad. This car is one of a lot made by the Fox Pressed Steel Equipment Company, and erected at the West Albany shops of the road in April of the present year. The weight of the locomotive, as shown, is 83,000 pounds, and the weight of the car is 29,000 pounds. The length of the car is 36 feet 8 inches and its width is 9 feet 8 11-16 inches, the height from rail to floor being 3 feet 8¾ inches. The low floor permits of carrying the locomotive, which would not be possible with a high car without stripping the engine of many of its parts. The car has the new Fox trucks, with 5 by 9 inch M. C. B. journals. We shall have more to say about the interesting car in a future issue.

The special equipment of its engines includes for both types the following: Crosby safety valves, steam gauges and whistles, Nathan sight feed lubricators, Westinghouse automatic air brakes on tenders and for trains, and Leach sanders. The consolidation engines have magnesia sectional lagging on boilers and cylinders and the ten-wheelers have the American outside equalized air brake on all driving wheels.

General Dimensions.	
10-Wheel Compound.	Consolidation.
Gauge	3 ft. 0 in.
Fuel	Coal briquettes.
Weight in working order	90,500 lbs. 91,000 lbs.
" on drivers	58,000 lbs. 82,000 lbs.
Wheel base, driving	13 ft. 2 in. 10 ft. 11 in.
" total	22 ft. 5 in. 17 ft. 2 in.
Cylinders.	
Diam. of cylinders... H P., 17 in.; L. P., 27 in.	16 in.
Stroke of piston	20 in. 20 in.
Horizontal thickness of piston	4¾ in. 5¼ in.
Diam. of piston rod	2¾ in. 2½ in.
Kind of " packing	Cast iron.
" " rod packing	U. S. Metallic.
Size of steam ports, H. P., 15 in. x 1⅝ in.; L. P., 18 in. x 2 in.	14 in. x 1¼ in.
Size of exhaust ports, H. P., 15 x 2¾; L. P., 18 in. x 2¾ in.	14 in. x 2½ in.
Size of bridge ports	1¼ in. 1 in.
Valves.	
Kind of slide valves ... Allen Richardson.	Richardson.
Greatest travel of slide valves	5⅛ in.
Outside lap of slide valves, H. P., 1⅛ in.; L. P., ⅞ in.	¾ in.
Inside lap of slide valve ... Clearance ¼ in.	Line and line, 0 in.
Lead of valves in full gear	1/16 in. 0 in.
Kind of valve stem packing	U. S. Metallic.
Wheels, Etc.	
Diam. of driving wheel outside of tire .. 48 in.	38 in.
Mat'l " " centers	Cast steel.
Tire held by	Shrinkage and lip.
Driving box material	Cast steel.
Diam. and length of driving journals, 7 in. dia. x 7 in.	7 in. dia. x 7 in.
Diam. and length of main crank pin journals (main side, 5½ in. x 4 in.). 4½ in. dia. x 4½ in.	Main, 4½ x 4½ in.; main side 5½ in. x 4 in.; inter., 7 in. dia. x 3½ in.
Diam. and length of side rod crank pin journals, 3½ in. dia. x 3 in.	3 in. dia. x 3 in.
Engine truck, Kind. ... 4-wheel swing bolster.	2-wheel swing bolster.
" journals ... 4¾ in. dia. x 7 in.	4 in. dia. x 7 in.
Diam. of engine truck wheels	31 in. 25 in.
Boiler.	
Style	Straight.
Outside diam. of first ring	52 in. 56 in.
Working pressure	200 lbs 180 lbs.
Mat'l of barrel and outside of fire box	Carbon steel.
Thickness of plates in barrel and outside of fire box ... 9/16 in., 5/8 in., 7/16 in., ½ in.	9/16 and ½ in.
Horizontal seams	Butt joints, sextuple riveted, with welt strips inside and outside.
Circumferential seams	Double riveted.
Fire box, length	49 9/16 in. 54 in.
" width	44⅛ in. 44⅞ in.
" depth	61 in. 60½ in.
" material	Carbon steel.
" plates, thickness, sides	5/16 in; back, 5/16 in.; crown, ⅜ in.; tube sheet, ½ in.
Fire box, water space, front	3 in.; sides, 2½ in. to 3 in.; back, 2½ in. to 4 in.
Fire box, crown staying	Radial, 1 in. dia.
" stay bolts	⅞ in. and 1 in. dia.
Tubes, material	Charcoal iron.
" number of	190 179
" diam	1¾ in. 2 in.
" length over tube sheets	10 ft. 7 in. 14 ft. 6 in.
Fire brick supported on	Studs.
Heating surface, tubes	1,048.53 sq. ft. 1,351.18 sq. ft.
" fire box	81.94 sq. ft. 81.60 sq. ft.
" total	1,130.47 sq. ft. 1,440.75 sq. ft.
Grate surface	15.33 sq. ft. 16.96 sq. ft.
Ash pan, style	Plain dampers.
Exhaust nozzles	4 in., 4¼ in., 4½ in. dia. 3¾ in., 4 in.; 4¾ in. dia.
Smoke stack, inside diameter	14 in.
" " top above rail	12 ft. 2½ in. 12 ft. 1½ in.
Boiler supplied by	2 Sellers Class N. 2 Sellers No. 7½
Tender.	
Weight, empty	31,000 lbs.
Wheels, number of	8
" diam	31 in.
Journals, " and length	4 in dia. x 7 in.
Wheel base	14 ft. 0½ in.
Tender frame	8 ft. channel.
" trucks. 4 whl. square wrot. iron frame.	Square wrot. iron frame.
Water capacity	3,000 U. S. gals.
Coal "	5¼ tons. 4½ tons.
Total wheel base of engine and tender	45 ft. 3½ in. 45 ft. 10½ in.
Total length of engine and tender	53 ft. ½ in. 53 ft. 11 in.



Longitudinal Sections, Elevation and Plan.


Roller 7" x 14"
Journal Box Bolts 1⅛" D
Column bolts 1⅛" diam.
Black 1⅞" x 14" x 13¾" long
15" Channel 48 lbs.
Angles 3½" x 4" x 6" x 7.5
1" Rods
1" bolts
1" Pin
4" bolt
33" diam.
Cms. Journals 6" x 11"
7 sq. Angles
5" x 1" Side Bearings
5" x 1" Brake Shoes

Details of Truck and Truck Bolster.

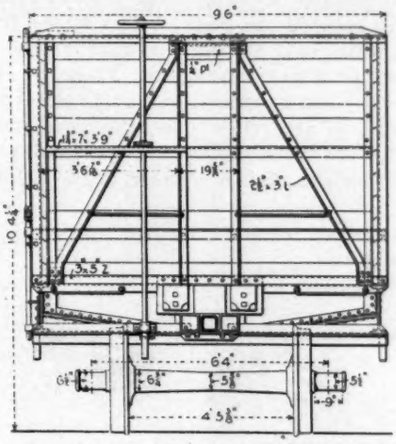
Coa ano Ore Car, 100,000 Lbs. Capacity, Northern Pacific Railway.

TWO NEW CAR DESIGNS—NORTHERN PACIFIC RAILWAY.

COAL AND ORE CAR, 100,000 POUNDS CAPACITY.

A hopper bottom coal car of 50 tons capacity, only 30 feet long and weighing 35,000 pounds, is a novelty even in steel car construction, and through the courtesy of Mr. E. M. Herr, who has just resigned as Superintendent of Motive Power of the Northern Pacific Railway, we are enabled to present an illustrated description of the interesting design, prepared under his direction, from which an experimental car is now being built for that road with a view of building a number for coal and ore service.

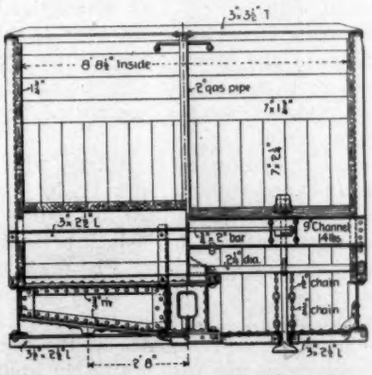
The car has a steel underframe and a wooden box, with sides



End Elevations and Sections—Coal and Ore Car.

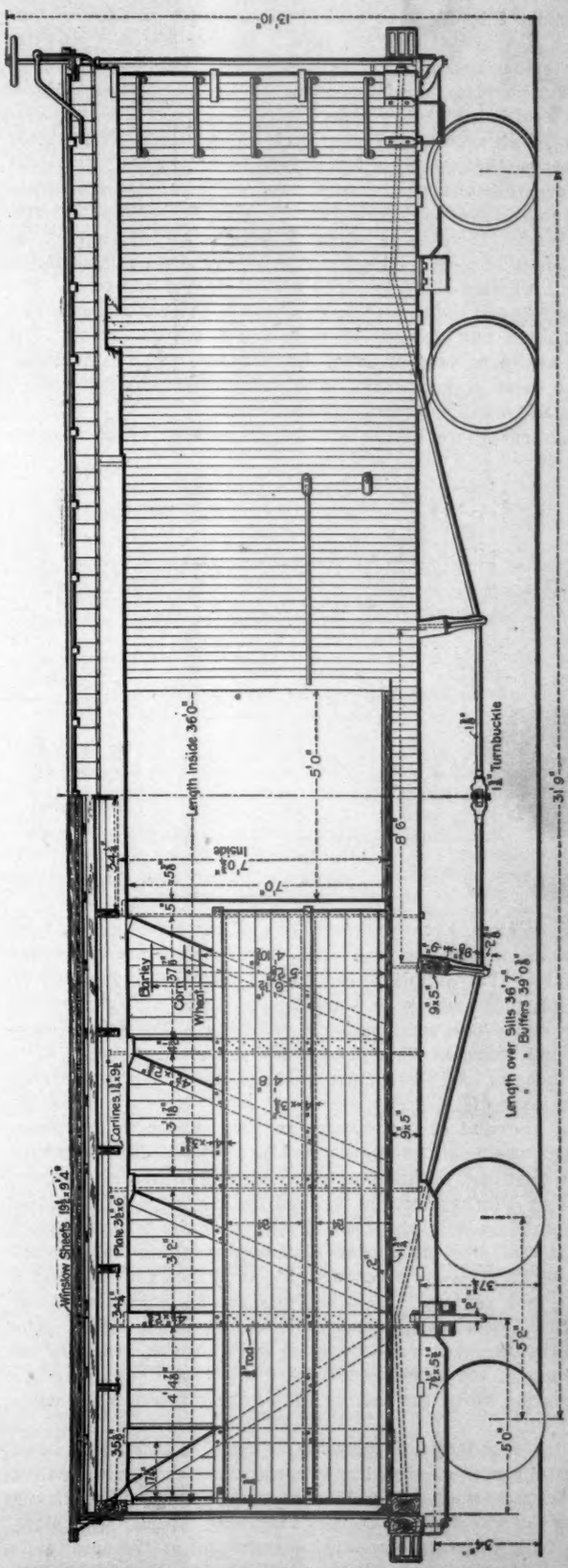
6 feet 6 inches high. The length over sills is 30 feet; the width over sills, 9 feet 6 inches; the height of body, 7 feet 9 inches; the height from rail to top of plate, 10 feet 4¾ inches, and the distance from center to center of trucks is 20 feet 8 inches. The drawings, which are reproduced in as much detail as possible, are worthy of study.

The underframe is very stiff, notwithstanding the presence of the hoppers, which renders it necessary to get along without intermediate sills. The center sills are in the form of a box



Cross-Sections of Coal and Ore Car.

girder constructed with 15-inch channels weighing 33 pounds per foot and 7-16 by 21 inch covering plates. The side sills are of 15-inch I beams, weighing 50 pounds per foot. The end sills are of special Z bars 2½ and 3 by 5 inches by 9 feet 6 inches. The dead blocks are secured to plates fastened to the ends of the box girder. The end and intermediate bracing is clearly shown in the drawings. The body bolsters have ¾ by 10 inch bottom and top plates with a center web ⅜ inch thick and fastened together by 2½ by ⅜ inch angles, the form of the bolsters being shown in the half section on line A—B. This view also shows the connection between the box girder and the bolsters, where it will be noticed that the cover plates extend over and under the box girder, while the webs of the bolsters are riveted to the channels of the girder. The center castings are of cast steel, riveted to the plates and channels of the girder. The center plates are of malleable iron.



Box Car, 70,000 Lbs. Capacity—Northern Pacific Railway.

The draft rigging has double helical springs with malleable iron lugs riveted to the channels, and the outer lugs, as seen in the sectional elevation at the left, form supports for 9 by

9⅝-inch oak blocks back of the dead blocks. The dead blocks are of cast steel.

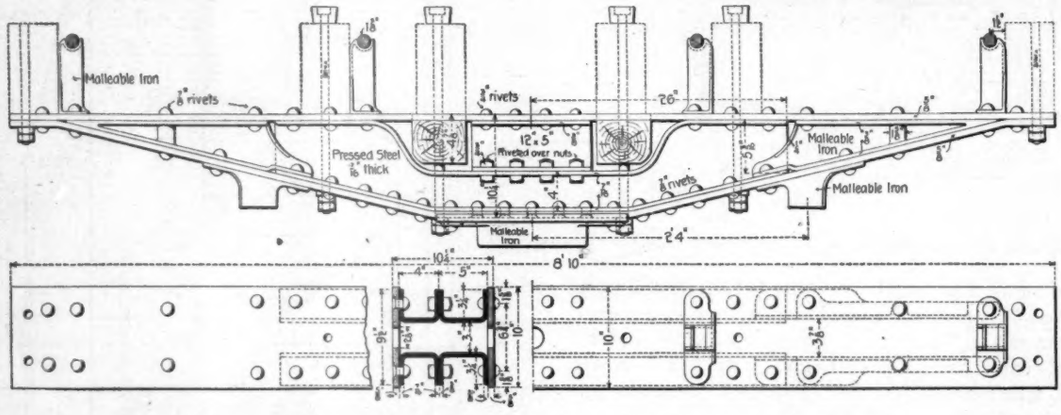
The body of the car is of wood, the siding and ends being of 1¾ by 7 inch Georgia pine, placed inside of the posts and braces. The sloping ends are lined with 2½ inch oak. The posts are 3 by 2½ inch angles, weighing 6.6 pounds per foot, the plates are 4 inch channels, 8 pounds per foot and the counter braces are of 2½ by 5 inch oak. The drop doors are of ¼ inch plate, reinforced with angles, the hinges being of cast steel bolted to the underframe. The doors are supported by 1¾-inch crow foot rods, which secure the doors by being turned so that the crow feet extend in a direction across the car and take the weight on the rods. These rods are turned by an arrangement terminating in squared shafts at the side of the car, these being operated from either the top or the bottom of the car. The doors are closed by chains passing over a winding shaft provided with a ratchet and pawl. The ridge between the hopper doors and over the box girder is of 8 by 21 inch oak, secured by bolts and straps as shown. The cars are to be used on long, heavy grades and the Westinghouse quick acting brakes, with independent auxiliary reservoirs and brake cylinders, are used.

The trucks are of the arch-bar type with roller bearing, swing bolsters, having three rollers of the Barber type, 2 by 14 inches in size, at each end. The bolsters are somewhat similar to the "Simplex," the tension plate being replaced by four 1⅝-inch rods, with a head on one end and nut on the other end. The compression member is a Pencoyd 15-inch 48-pound channel. The spring plank is formed of two ⅝ by 4 by 6-inch angles. The springs are in groups of five, each spring being made of 1⅛-inch steel, and a block of oak is fitted between the end of the bolster and the upper roller plate, whereby the height of the car may be adjusted. The arch bars are very strong, the top one being 1½ by 5 inches; the bottom is 1⅜ by 5 inches and the pedestal tie bar is 1⅝ by 5 inches. The brakes are inside the wheels and the wheels are of chilled cast iron, 33 inches diameter, weighing 750 pounds each. The axles are steel, with 5½ by 9 inch journals and 6 feet 4 inch centers. The wheel fits are 6⅝ inches diameter and the diameter at the center of the axle is 5⅝ inches. The journals have collars and the axles are shown so clearly in the drawings of the truck as to render a separate engraving unnecessary. All of the cast details of the trucks are malleable iron.

In the description no pretense is made of indicating all of the details of the design, but with the aid of the drawings they will be understood. The object of this design is to produce a strong car which shall have large carrying capacity with minimum length and dead weight of train and at the same time to provide means for easily renewing such parts as are likely to become worn out in service. The large capacity, compared with other cars of this length, is obtained by carrying the hoppers down to the lower faces of the sills and by making the waste spaces at the ends as small as practicable.

BOX CAR, 70,000 POUNDS CAPACITY.

The Northern Pacific Railway has 1,000 box cars under construction, the design of which is shown by aid of the accompanying engravings. These cars are 36 feet long and of 70,000 pounds carrying capacity; they are 8 feet 10 inches wide and 13 feet 10 inches high over all. The longitudinal sills are 5 by 9 inches in section and 36 feet 7 inches long; there are six of them arranged as shown in the sectional view of the body bolster. The specifications call for either long leaf yellow pine or Washington fir, and each end is fitted with malleable iron pockets. The end sills are of oak, 6 by 9 inches, and the needle beams, draft timbers, dead blocks, auxiliary sills, posts and braces are all of white oak, and the posts and braces are fitted with malleable iron foot pockets. There are two auxiliary sills 2½ by 9 inches between the needle beams at the doors. The girths are of white oak, 3¾ by 4 inches, the side and end plates are of 3½ by 6 inch yellow pine. There are eleven oak carlines, 1¾ by 9½ inches, secured to the side plates with strap bolts. The purlines are yellow pine. Tongued and grooved pine is used for the inside lining and the flooring is yellow pine. The truss rods are four in number, of 1⅜-inch iron, with 1¾-inch ends, the rods are tightened to give the car 1 inch camber at the center. The cars are equipped with "Chicago" roofs, 1892 pattern, with ⅞ by ½ inch pine strips between the rafters. The outside sheathing is 25/32-inch thick and 5⅛ inches wide, tongued and grooved and double beaded on the face. The grain doors are also of the "Chicago" make, with the vertical rods rabbeted into the door posts. The cars are to be used chiefly for grain.



Box Car, 70,000 Lbs. Capacity—Northern Pacific Railway—Body Bolster.

The couplers are the Tower, M. C. B. type, with 1 by 4 inch spring pockets; they are equipped with 1½ by 6 by 12¼ inch followers, with two projecting bosses for double springs and the draft timbers are protected by ⅜-inch pressed steel plates fitted with malleable iron draft lugs. The draft springs are 6 by 8 inch double coil. The body bolsters are made of two ⅝ by 10 inch soft steel plates, fitted with pressed steel web filling pieces shaped to fit the plates at the center and between the side bearings and with malleable iron fillers over the side bearings and at the ends, the whole structure being secured by rivets, as shown in the drawing. The center plates are of malleable iron with ⅜-inch steel liners; all of the castings except the brake wheels and pocket washers are of malleable iron. The cars have Westinghouse brakes, with retaining valves.

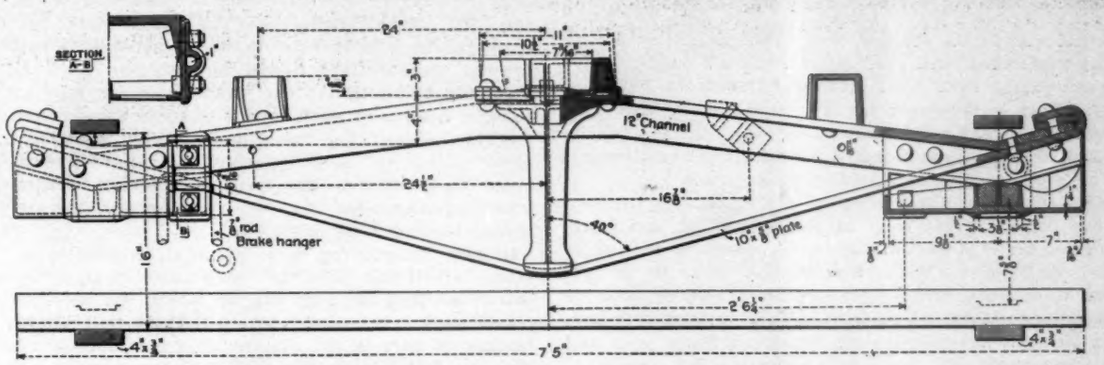
The trucks are of the Barber roller bearing arch bar type with Bettendorf bolsters, the axle journals being 4½ by 8 inches, with the wheel fits 5⅝ inches diameter and the center of the axle 4⅞ inches diameter. The wheels are 33 inches diameter, of chilled cast iron, weighing 600 pounds each.

Of this lot of 1,000 cars, 500 are being built by the Illinois Car & Equipment Company of Chicago and 500 by the Michigan Peninsular Car Company of Detroit.

SIMPLEX TENDER TRUCK BOLSTER.—CHESAPEAKE & OHIO RAILWAY.

The tenders for the new Class G-6 consolidation freight locomotives of the Chesapeake & Ohio Railway, designed by Mr. W. S. Morris, Superintendent of Motive Power, have Simplex truck bolsters, made by the Simplex Railway Appliance Company, Fisher Building, Chicago, to the design shown in the accompanying drawing.

The tenders have metal underframes and weigh 87,000 pounds when loaded with 4,500 gallons of water and seven tons of coal, and are carried on two four-wheel trucks, with 33-inch wheels. The design of the bolster is not unlike the usual practice of the manufacturers. The 12-inch channel used for the upper or compression member weighs 35 pounds per foot, and



Truck Bolster for Standard Tender Truck—Chesapeake & Ohio Railway.

the tension member is a 10x⅝-inch plate. The drawing very clearly brings out the construction at the ends of the bolster, and the form is seen to be planned for the purpose of carrying the stresses upon the important members of the bolster, so as to require no service from rivets, except to hold the parts together. The bolsters are very light and a specially strong claim is made for this type of bolster for combined lightness and strength. The total number of pieces in the bolster is small, and the castings are all of malleable iron. We are indebted to Mr. Morris for the drawing.

A STEP TOWARD UNIFORMITY IN SIGNALING.

The Railway Signaling Club has undertaken a useful work in recommending methods of constructing details of interlocking signal apparatus, which, if persistently followed up, will lead to systematizing the present chaotic condition of interlocking practice. At a recent meeting of this organization a committee made a report based upon certain parts of an excellent paper presented last year by Mr. H. M. Sperry, after ascertaining the views of the members by letter ballot. The conclusions of the committee were substantially as follows:

Switches should be designed specially for interlocking work, having a lock rod at the point and a switch rod on the opposite side of the head tie, the center of the switch rod being 14 inches from the point; connection to be made by a threaded rod with jam-nuts on each side of a cage furnished with thimbles, to prevent wear to threads and allowing a play not to exceed 2 inches; the thimble to be riveted to the center of the switch or head-rod in all cases where ties can be properly tamped and adjustment is easy of access. In all other cases, as, for instance, at slips, etc., the end of switch rod should be bent down at right angles, and a rod passed through it, instead of a cage, bringing the adjustment beyond the end of the ties. Instead of the usual tang at the end of the threaded rod, an eye engaged with a screw jaw will be found very convenient for adjusting the switch when no change of throw is required, and for furnishing a jointed instead of a rigid rod, (especially advantageous at slip switches). These latter devices should be used only when limited room requires their employment, as they are complicated, difficult to maintain from a trackman's standpoint and hard to protect properly with bars. For their operation we advocate rocker shafts with arms set-screwed or pinned from the top, leaving a smooth surface on the under side, where ice usually forms, and having bearings designed to bring the shafts as near the base of rail as the length of the arms will safely permit. Only in isolated cases of single slips will cranks be found preferable. We recommend the outside facing-point lock with nearly straight lock-rod, having a screw jaw at one end connected to a lug on the front rod, this front rod in turn having a screw jaw at one end, where it catches the foot. By this means the throw of the switch can always be kept the same within small limits by varying distances between points, effecting a saving in labor of washering out the points, etc., and making all lock rods interchangeable (a marked advantage in case of wrecks).

We recommend in all new work separate levers for all signals, and that selectors be used only for slow speed routes in yards where indicators are used. We also recommend the use of bolt locks or their equivalent, placed in the connections of all high speed signals, and protecting all facing-point switches in these routes. In order to avoid complication of connections, we suggest centering springs where facing points are beyond the tower; or, if switch levers are heavily loaded, the employment of electric locks, to be withdrawn when the switch is thrown more than three-quarters home, thus obviating the necessity of careful adjustment of the electric lock itself. An interlocking facing-point lock recently devised could be used advantageously in many places.

We recommend as a standard easily adopted by all roads a distance of 5 feet 6 inches between centers of semaphore arms, with 5-foot blades for high speed arms and 3 feet 6 inches for short arms when used; pipe connections to all home signals, and to distant signals where the run is not too long for operation; wire to dwarf signals if idle jaw is used for operating them.

Iron poles are favorably spoken of by all who use them. We would recommend that they be made of trolley pole pipe and set in cement on the lines of Mr. Elliott's design, which we believe represents the best practice. (These were illustrated in the "American Engineer," September, 1898. Editor.

Levers should be grouped in small machines with signals on the ends, switches and locks in the middle. In large machines they should be grouped as best facilitates manipulation.

Train order signals should release distants mechanically if in the same frame, electrically if otherwise. We recommend that engineers report all distant signals found against them, and rear brakemen all signals not set to protect them after passing a stated distance. Mr. Sperry advises that he has an automatic checking device for distant signals.

We recommend that all signals not plainly seen from the tower be provided with repeaters requiring only two wires; contact when closed holding arms horizontal. Any opening of the circuit due to a broken wire or an arm drooping will allow the indicator to drop to clear by gravity; it is cheap and effective, and a bell can be added if desired.

A burnished finish on the journals of axles for cars and locomotives has given good service and has been practiced on many roads for a long time. The advantage of it is to smooth the surface of the journal after the finishing cut and shorten the period of breaking in. The burnishing is done by three rollers carried on a tool rest and bearing against the journal, considerable pressure being obtained by a screw. The rest is fed along so that the finishing cut and the burnishing are done in the same time. Mr. Atkinson, of the Canadian Pacific, uses the burnisher on piston rods and intends to use it on valve rods as well as on journals. He stated at the recent Master Mechanics' convention that it gave the best finish that he knew of for piston rods.

COMMUNICATIONS.

GRATE AREAS, HEATING SURFACES AND CYLINDER VOLUMES.

Editor "American Engineer":

Referring to the matter of proportions for locomotives burning bituminous coal, as suggested in the communication by "C. G. O." on page 260 of your August, 1898, issue, and in view of a recent discussion in the Northwest Railway Club upon heating and grate surfaces, I desire to record that my experience leads me to adopt for bituminous coal burning engines the following figures: For road engines 2.4 square feet of grate surface to a cubic foot of cylinder volume; for switch engines, 2 feet; for heating surfaces in both road and switch engines, 80 square feet to 1 square foot of grate area.

All soft coal burning engines should have a deflector, either in the form of a water leg or brick arch with deep fire boxes or an upright wall in the shallow ones. The upright wall may be partially perforated with good results. An air supply above the fire, amounting with most bituminous coals to 1-50th of the grate surface, is necessary for economical work. The only requirements in regard to this air supply are that it shall be near the line of fire, be composed of comparatively small openings and without direct communication to the tubes.

These proportions are closely reached in a great many modern engines, but there is great want of uniformity yet, and many roads are using much more coal than is necessary on account of imperfect construction. With the shallow box it is advantageous to make a fire box considerably larger than is needed, the space not needed for grates being bricked over and, in connection with a vertical wall, forming a flame way and combustion chamber.

Another need that we expect to have filled in the near future is a better form of tube for effecting a more complete absorption of the heat from the burning gases into the water. The difficulty with patterns now in the market is their high cost, but I feel that this will be remedied sooner or later.

C. M. HIGGINSON,
Assistant to the President.

A., T. & S. Fe Ry., Chicago, September 17, 1898.

[Mr. Higginson has advocated ample heating surfaces for a long time, and has urged more attention to the admission of air and to giving flame way enough to produce complete combustion. The article by Mr. M. N. Forney on another page of this issue is commended to the reader in this connection. There is no more important subject in locomotive design than proportions affecting combustion. There is much to think about in these sugestions, and we shall be glad to have the opinions of other readers.—Editor.]

SIDE BEARINGS FOR CARS.

Editor "American Engineer."

I was considerably interested in reading the editorial in the September issue of the "American Engineer" on the subject of side bearings for cars.

The advent of heavy cars of 80,000 and 100,000 lbs. capacity has brought one great blessing at least. It has forcibly called attention to the fact that it is absolutely necessary for safety and efficiency to relieve the flanges of the wheels from the great strain, and consequent friction and wear upon them, caused by cars carrying the loads almost as much upon the solid side bearings as upon the center plates. From time to time in the past, attention has been called to the necessity of having the trucks swivel freely, but the subject has at no time been so generally under consideration as at present.

In the past in the designing of cars on most roads, the space between the top of the truck bolster and bottom of the car sills has been so small that it was practically impossible, without increasing it, to get sufficient depth for a body bolster to successfully carry loaded cars of from 60,000 to 100,000 lbs. capacity and support the load on the center plates. Most of the recent cars of 80,000 and 100,000 lbs. capacity have been constructed with steel under-framing, and in the case of coal and ore cars have a steel superstructure. The whole design of these cars has been on entirely new lines, and instead of being confined to a limited distance below the sills for the body bolster, it has been possible to make the bolster with no limit to depth, except what was required to make it carry the side sills of the car with their proportion of the load, with absolutely no appreciable deflection. With such a strong body bolster it was found that the side bearings kept apart and the load was, as far as possible, carried on the center plates. Of course, trains of cars so equipped were found to haul much easier; and there was an absence of squeaking of wheels when passing around sharp curves. Manufacturers of steel cars called attention to this good feature of their construction and design, and as a result considerable investigation has been made as to the condition of bolsters and side bearings on older cars, with wooden framing. The investigation has shown that almost nine out of ten of the older cars, on most of our roads, are running with side bearings in contact, even when the cars are empty; undoubtedly when loaded a large percentage of the load is carried by the side bearings. It is in most cases impracticable to apply new and sufficiently stiff body bolsters to our older cars so that they would ride with the load carried entirely on the center plate, for the application of such body bolsters would necessarily raise the cars beyond the standard height for the center of the drawbar. The only thing that seems practicable for relieving the side bearing friction on such cars is to apply some form of frictionless side bearing. This has been done very satisfactorily on several roads in the country, where they have had to deal with many sharp curves. The result of the anti-friction side bearings on flange wear has been very marked, the service of the wheels being greatly extended.

In new designs for cars, where it is possible to have distances which will allow the construction of an amply stiff body bolster so that the load can be carried on the center, such a result should be sought for; but it is well known that the loading of cars is not always adjusted and balanced so that the cars will ride on the center. Many times, especially with coal and ore, the load on one side of the car is considerably more than on the other. As a result, such cars, in spite of being center bearing cars, will ride constantly on the side bearings on one side, producing the resultant friction and flange wear. It is also true that in going around curves at speed, the centrifugal force will throw the load quite largely on the outer side bearing. Such being the case, there seem to be very strong and reasonable arguments for the application of frictionless side bearings on cars of future design, even though it may be possible to keep the side bearings apart, with the load on center plates, under normal conditions.

It is very necessary, if in time the body bolsters or the truck bolsters become so settled or distorted as to allow the side bearings to come in contact under heavy load, to have as nearly as possible a frictionless contact at the side bearings.

Some months ago, the subject of carrying load on center plates or on side bearings was discussed before the Western Railway Club. I took the ground, as the result of examination that I had recently made of some old cars, that it was a reasonable conclusion, provided side bearings could be made anti-friction, that the ideal way of transmitting the load, considering the service of the truck bolster as well as freedom of swivelling in the truck, would be to have the load divided between the side bearings and the center plates. My reason for taking that ground was, as I stated at the time, that it would not do to carry the load on the ordinary center plate and then have the common cast iron or malleable iron side bearings in contact. I stated that I believed it was worthy of consideration, in designing heavy capacity cars, to consider the advisability of applying some device so that the bolsters would carry the load distributed between the side bearings and center plate. I have given the subject considerable consideration, and am convinced that it will not do to depend, in the very heavy capacity cars, upon carrying the load of the car entirely on the center plate, without providing means for freedom from excessive friction, when the load is so adjusted that the cars will settle down on the side bearings on one side. Hence my conclusion is that:

The design of bolster should be of such a character as to carry the load on the center plate, with the side bearings in normal condition a short distance apart, possibly ⅜ inch or ½ inch, then provide anti-friction side bearings of some kind so that in rounding curves, or when the load is unevenly distributed, the trucks will be free to swivel and adjust themselves to the track without excessive flange friction and wear.

Fortunately during the past year, body bolsters have been

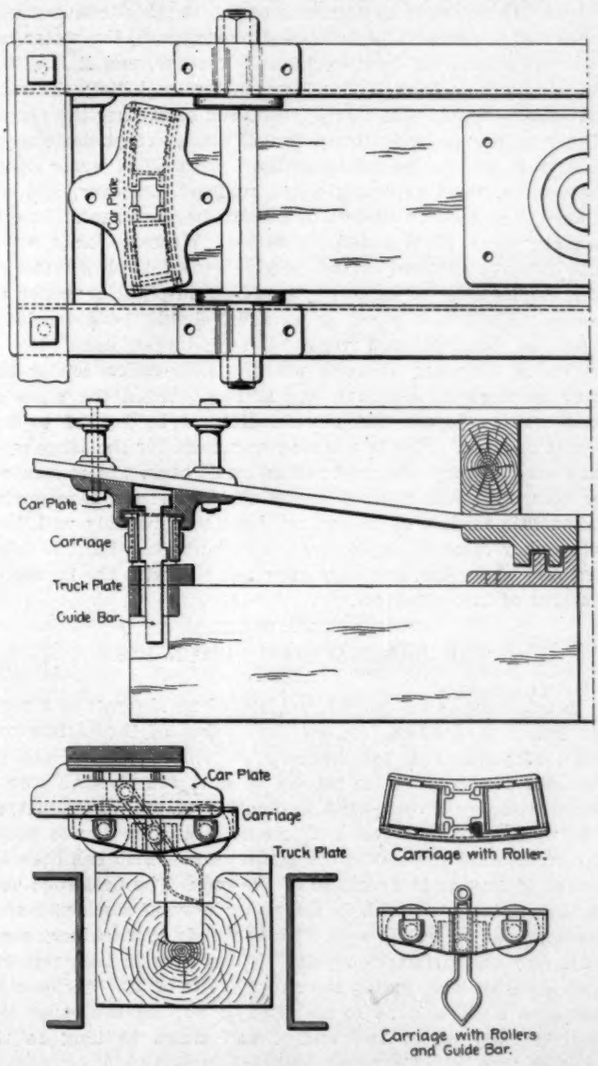
developed which may be safely depended upon in carrying the heavy loads now placed in cars, without the bolsters showing any excessive deflection which would bring the side bearings in contact if they were originally ⅝ inches or ½ inch apart. Prior to last year, very few, if any, bolsters have been designed which would permanently carry the loaded cars on which they were supported without the side bearings eventually coming in contact.

A. M. WAITT,
General Master Car Builder.

Lake Shore & Michigan Southern Ry., Cleveland, Sept. 13, 1898.

THE SUSEMIHL-TORREY CAR SIDE BEARING.

Of late we have given considerable prominence to the subject of side bearings for cars, which is important on account of the increasing weight and capacities of rolling stock. Many attempts to use roller bearings have failed on account of the tendency of rollers to become flat, resulting in a somewhat worse condition than obtained with ordinary bearings. If



The Susemihl-Torrey Side Bearing.

roller bearings are so constructed as to compel the rotation of the rollers with every movement of the bolsters, one of the objections to their use will be overcome, and through the courtesy of Mr. Robert Miller, Superintendent of Motive Power and Equipment of the Michigan Central Railroad, we illustrate the Susemihl-Torrey side bearing, now in successful use under all of the passenger cars on that road. In this design the construction is such as to give a positive movement of the rollers, compelling them to roll when the car strikes curves. The increased effort required to pull cars with the trucks cramped is very expensive, as has been shown by Mr. A. E. Mitchell (See American Engineer, July, 1898, page 229), and the subject is worthy of much more attention than it has received.

Our engraving shows the construction of the bearing, with which some of our readers are doubtless familiar. There are two bearing plates: one fastened to the transom of the car, the other to the bolster of the truck. Interposed between these lies a carriage confining two cone-shaped rollers. The rollers are cone-shaped to conform with the center of motion, to avoid twisting and sliding of the rollers. The bearing surfaces have a hollow cone-shaped form for making the movement of the rollers perfect. The carriage has flanges on top which engage in grooves of the top casting.

The main feature of the device is a bar which is pivoted in the top casting and engages with a center pivot in a slot formed in the carriage, and rests with a third pivot in the bottom part of the bottom casting. The center pivot is an equal distance from the centers of both end pivots. While the top casting with the car moves away from the original position in relation to the bottom casting in the truck, the pivot bar travels upward in the box of the bottom casting, and the center pivot travels upward in the slot of the carriage, thereby controlling the position of the carriage and holding it always in the middle between the top and bottom casting on any curve. Without this pivot bar the carriage and rollers might gradually become displaced, but any tendency toward displacement is counter-acted by the pivot bar. When the top casting is bolted to the transom of the car, the carriage rollers and pivot bar stay with the top casting. In jacking up a car for repairs no difficulty arises; the bottom casting being bolted to the bolster of the truck stays with the truck, the pivot bar draws out of the box opening of the bottom casting, and all the parts are lifted up with the car. When the car is lowered, the pivot bar being pointed at the bottom inserts itself into the box of bottom casting and the rollers find their proper position on the bearing plates. The rollers are common chilled castings. Both bearing plates have chilled surfaces and are also common castings. The carriage is made of malleable iron. The pivot arm is either malleable or forged. This bearing may be used on most passenger cars and under certain classes of freight cars, where sufficient space is given between the transom of the car and the bolster of the truck or where the bolster may be cut away for the bottom end of the pivot bar; or with such freight trucks as have no bolsters. A new patent has just been granted to the same gentlemen for a side-bearing which may be used under all cars, even if the space between the bolster and transom is only five inches. According to that patent the guiding bar is made in two parts, one pivoted to the top casting and one pivoted to the bottom casting, both guide bars passing through a swivel bar pivoted in the carriage.

THE SHANSI COAL MINES—CHINA.

Advance sheets of consular reports giving details of the concessions made by the Tsung-li-Yamen of China to the Pekin syndicate of London, have been received. Of the extent and value of the deposits to be worked, Consul Ragsdale says:

"In the eastern portion of the province, and running into the province of Honan, are deposits of anthracite coal. The western half has bituminous coal covering some 12,000 square miles, and all along the western boundary are deposits of petroleum. At many different points in the coal region are deposits of rich iron ore. The coal strata are practically horizontal and at an elevation of about 2,500 feet. They show wherever erosion has cut to a sufficient depth. This anthracite coal vein is unbroken over an area of 13,500 square miles, and its thickness varies from 25 to 50 feet, an average of 40 feet. All of this deposit is within the limits of the concession.

"There are thousands of native coal mines now in operation, and the coal has been used for probably 3,000 years. The iron ore is now worked by the natives. This entire region has been examined by William H. Stockley, mining engineer, and Charles D. Jameson, Civil Engineer, both Americans, and in the employ of the syndicate. There is probably no coal field known in the world that can compare with this of Shansi, either in quality or quantity of coal or the possibility of cheap production."

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Contributions.—*Articles relating to railway rolling stock construction and management and kindred topics, by those who are practically acquainted with these subjects, are specially desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase or construction.*

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Side bearings vs. center plates, or the manner of carrying the load from body bolsters to truck bolsters of cars was discussed briefly last month, and in this number there are two contributions to the subject, one from Mr. A. M. Waitt, of the Lake Shore & Michigan Southern, and the other describing the side bearing that is advocated and extensively used by Mr. Robert Miller, of the Michigan Central. Mr. Waitt takes the view that "frictionless" side bearings ought to be used anyway, whether the bolsters are stiff enough to carry the load without undue deflection or not. His position is a reasonable one, because side bearings must sometimes be in contact, and when they are touching there is need of an easily moved contact. The loading of the car may be irregular, with more weight on one side than on the other, curves will cause the bearings on one side to come together owing to centrifugal force, and in time distortion may give a permanent contact, even if the original strength of the bolsters is ample. Arguing from these premises, good side bearings that will not stick or rub hard, are desirable, even with stiff bolsters. From the other article on side bearings it may be inferred that Mr. Miller's experience with the Susemihl-Torrey side bearing is good ground for believing that the principles used in its construction are correct.

It is probably an idea of economizing that prompts some railroads to manufacture pistons and other parts of air brake triple valves for their own repair work, but there can be no doubt that this is a mistake. The air brake manufacturers have learned at enormous expense that the triple valve is a delicate piece of mechanism that justifies any amount of cost for special machinery and perfection of workmanship. Those who have seen these valves made are convinced that they cannot be replaced in an ordinary shop, and it is evident that even slight variations from the standard work that must exist in these homemade parts may in time prove to be a serious source of annoyance and expense.

Track tanks for supplying locomotives with water while running have been in high favor, chiefly because of the saving in time which their use made possible. Opinion is rapidly changing, however, and their abandonment by the Maine Central is a sign of this. They do not pay under the conditions of operation which now generally obtain in this country. The tanks are expensive to build and to maintain, the water must be prevented from freezing in cold weather, and it is difficult at all times to keep it free from cinders and dirt; the tender attachments also cost a great deal, and altogether the elevated tanks appear to be preferred for all cases, except those requiring long runs without intermediate stops. The water column system on most railroads needs revision, however, and it is likely to be made a subject of general improvement. This has already been inaugurated on several Western roads by the use of tanks elevated enough to give a good head of water and the employment of large pipes and stand-pipes or water columns. Eight-inch pipes, or smaller, should be discarded as soon as possible and replaced with larger ones, say 12 inches in diameter, through which a 4,000-gallon tender tank may be filled in less than one minute. When the pipes are small, delays occur and more coal must be burned to keep trains on time. This is a strong argument for the large pipes, and even if they cost more than small ones, the money will be returned many fold. Some of the best roads have not yet taken this subject up in earnest, but they probably will do so when they come to appreciate the advantages. Station delays are very expensive, and they grow more so with the increasing number of fast schedules.

THE BREAKAGE OF PISTON RODS.

In our issue of last month we printed an abstract of a paper by Mr. J. E. Johnson, Jr., on the subject of the carbon contents of piston rods for locomotives, which recorded the experience of the author in the use of steel and Swedish iron in piston rods on a compound locomotive of the Vauclain type. The rocking of crossheads of locomotives often causes rather severe bending stresses in the piston rods, which has been the source of trouble in breakage of the rods. The first rods used in the engine dealt with in the paper were of steel, and after breaking they were replaced with new rods of machinery steel, with very unsatisfactory results. These were in turn replaced with Swedish iron, giving the shortest life of all. Nickel steel was then tried, and up to the time of writing the paper this material had lasted two and a half times as long as the Swedish iron.

Presuming that the conditions of service, except as to the material used in the rods, were unchanged during this time this experience shows conclusively that steel is better than iron for such severe work. It would be valuable to know the relative tensile strengths and the limits of elasticity of these different materials, but the author of the paper does not tell us. It may, however, be assumed that the elastic limit of the nickel steel was far above that of the others, and herein is an element of great importance in all cases where repeated stresses occur. The ideal material for such service is one having sufficient hardness and at the same time enough ductility,

and steel having a very high elastic limit without a correspondingly high tensile strength would probably be the most favorable for this purpose.

An important question of design that should not be lost sight of here is the turning down of the parts to prevent the localization of the bending stresses near the ends of the rods. Professor Sweet has suggested that piston rods be made stronger by being made weaker, transversely. If these rods were made smaller at the crosshead ends by turning them down, for as much of their length as space would allow, and making the corners well rounded to give large fillets, the bending due to the rocking of the crossheads would be distributed over a larger part of the rod, which could not fail to be an advantage. This principle has been very successfully carried out in the construction of very high speed marine engines where great difficulty has been experienced with breakage from similar causes, the best example being in the practice of changing the sections of connecting rods at the crank pin ends from a circular to an elongated one, with the longer dimension parallel to the axis of the crank pin. This is done by Mr. C. D. Mosher, in his famous high speed steam yachts. We believe that the same idea might be carried out to a sufficient extent in locomotive work. That weakening the rods will make them last longer appears paradoxical, but the proposition is a reasonable one.

THE DUMMY COUPLING.

The present dummy coupling is not to be defended, but when a device is badly needed and a perfectly satisfactory one is not immediately available, it would seem to be a wise and good business policy to get along with an imperfect one while seeking for a satisfactory solution of the difficulty, instead of discarding that which, while defective, does its work partially. This was done by the Master Car Builders' Association recently in cutting the dummy coupling out of the list of recommended practices of the Association. We do not believe this to be a good way to treat the subject. It would be better at least to accompany this action by provisions for replacing the present dummy with something better, since it is generally admitted that there is a great need for a device to do what the dummy was planned and yet failed to do, and which at the same time will avoid the serious faults of that device.

The prime object of the dummy was to keep dirt out of the end of the hose when not coupled up, and the present device not only fails to do this on account of imperfect closure of the end of the hose, but it is, as generally applied, actually detrimental on account of kinking the hose, causing early failure of the rubber. A device that would keep the dust out and also permit of hanging the hose up without kinking is worth considerable trouble to get, and we believe that this result will be attained and that the Association will take up with the dummy again. If a committee had been appointed at Saratoga and instructed to investigate and report on a proper substitute for the faulty dummy they would at once discover the existence of a new one that apparently has all the qualifications of success.

The air brake has become too important to neglect, and when dirty triple valves are worrying so many motive power officers it is strange that there is anything like apathy in the attitude on this question, especially because its solution is not to be classed among the difficult ones. A coupling that is designed to be tight and then is well made so as to exclude dust is not a difficult thing to produce, and it need not be expensive to make and maintain. This will dispose of the introduction of dust and dirt into the air brake pipe, and by the use of a short piece of chain, which will permit the hose to hang in a natural curve and avoid the kinking that has been the cause of disintegration of so much hose, the other objection to the present device will be removed.

A good thing for immediate application is the short piece of chain attached to the present dummy. Then if the rule requiring hose to be hung up when not in use is enforced, the next logical step, a better dummy, is in order.

An air brake inspector in a recent experience trip visited one of the roads that has discarded the dummy, and in examining the condition of triple valves removed from service found many of them in very bad shape from foreign matter after from ten to twelve months' service, but strange to say they all worked. The road removes freight triples from the cars after about a year's service and sends them to the shop to be cleaned, and while the valves ought to be overhauled as often as that on general principles, the larger portion of this plethora of dirt should be kept out.

The action on the dummy coupling has been spoken of as "very hasty," and we are inclined to think that there are many members of the Association who would like to see it disposed of in a different way.

THE ATLANTIC CITY FLYER—PHILADELPHIA & READING RAILWAY.

Train No. 25 on the Philadelphia & Reading, which ran from Philadelphia and Atlantic City during the months of July and August of last year, ran also during the same months this year, and the wonderful record of its speed and punctuality, recorded for last year on page 426 of our issue of December, 1897, has been practically equaled this year, and the train has justly earned the title of the fastest train in the world.

The Baldwin Locomotive Works built several new engines this year with a view of increasing the speed of the train or making its punctuality more certain, and the results have been perfectly satisfactory. The editor of this journal enjoyed the privilege of a ride on the engine that hauled the train August 23. It was a most interesting and instructive trip. The engine, the track, the train and the manner of handling the train in every particular were noteworthy. The time was taken at the mile posts and the fastest mile was made in 42¾ seconds, at the rate of 84.21 miles per hour. The conditions of the run were normal in every respect, and therefore the record here given may be taken to show the regular working of the train rather than an extra fast trip. The time for the whole trip of 55.5 miles was 47½ miuutes, or a rate of 70.08 miles per hour for the entire run from start to finish. We are told that the fastest trip of the season was made in 44¾ minutes, or at the rate of 75.3 miles per hour, and the regular schedule time is 50 minutes, or 66.6 miles per hour.

The engine, No. 1,028, is of the Atlantic type, like No. 1,027 that hauled the train last year, except that the valves are 12 inches in diameter, one inch larger, and while the schedule is the same as last year the train has one more car on Saturday of each week and no difference seemed to be made in the running. The weight of the train on the day of record was: One combination car, 57,200 pounds; four coaches, each 59,200 pounds, and a Pullman car, weighing 85,500 pounds, a total, including the weight of the engine, 227,000 pounds, of 606,500 pounds.

The engine had 84½-inch drivers and in other respects the dimensions are as given in our article of last December. Its riding qualities were such that the writer had no difficulty to read stop watches without standing up, and this is enough to show that the engine rides well. Naturally the timing required a great deal of attention, but such observations as could be made of the running of the engine were revelations. The success of the train is due very largely to the enginemen. Mr. Charles H. Fahl was the runner and Mr. John T. Pettit the fireman. The coal was known as "Tunnel Ridge" anthracite, a good quality, and the steam pressure did not vary but 3 pounds from a pressure of 205 pounds during the entire trip. The throttle was opened but little and it was not changed during the run, and but one change was made in the boiler feeding, the right hand injector was used on the first half of

the trip, and then the other was substituted for it. The cut-off was as short as it could be made with the notches given, and we are told that it was 10 inches in the high pressure cylinder. The water evaporated averaged about 54 pounds per mile, and approximately two tons of coal were burned.

There were no hot journals about the engine at the end of the run, and it will not be surprising to be told that the engineer selected for this train has had a long, good record, and especially in regard to fuel economy. The engine steamed freely and the fireman, while very attentive to the fire, did not work as hard as many do on comparatively easy runs. The grate area is 86 square feet. The power of the engine is abundant for this work and we think its limit was not nearly reached in the trip recorded.

The timing of the train is given below, the train sheet times having been copied from the train dispatcher's sheet.

Timing of Atlantic City Flyer August 23, 1898.
Left Camden 3.50¼ p. m.

Mile Post.	Time.	Mile Post.	Time.
55	1.36½	27	.44
54	1.22½	26	.44½
53	1.03	25	.45
52	.59	24	.45
51	.59½	23	.44
50	.58½	22	.46
49	.54½	21	.45¾
48	.53¼	20	.44¾
47	.49½	19	.45
46	.50¼	18	.42¾
45	.49	17	.44
44	.46¼	16	.45¼
43	.47	15	.45¾
42	.50½	14	.46
41	.52½	13	.46
40	.53¾	12	.46¼
39	(Missed mile post)	11	.45¾
38	1.41½	10	.44¼
37	.48	9	.44½
36	.45	8	.45
35	.46½	7	.46¼
34	.45½	6	.46¼
33	.48	5	.44½
32	.44	4	.46½
31	.45	3	.50¼
30	(Missed mile post)	2	.53½
29	1.31½	1 (Drawbridge)	1.11
28	.45¾	Atlantic City (Stop)	1.46

Arrived in Atlantic City 4.37¾ p. m.

Train Sheet Record.

	Miles.	Time.
Camden	...	3.50¼
West Collingswood	3.10	3.56¾
Haddon Heights	5.5	3.58
Magnolia	7.9	4.00
Clementon	12	4.03¼
Williamstown Junction	17	4.07¾
Cedar Brook	19.9	4.09½
Winslow Junction	24.5	4.12¾
Hammonton	27.6	4.15½
Elwood	33.8	4.20½
Egg Harbor	38.7	4.24½
Brigantine Junction	43.5	4.27¾
Pleasantville	50.5	4.33
Meadow Tower	53.8	4.35
Atlantic City Depot	55.5	4.37¾

Time for trip from start to stop, 47½ minutes.
Average speed for trip in miles per hour, 70.08.
Fastest mile in 42¾ seconds, or 84.21 miles per hour.

NOTES.

Tests on six-inch Krupp armor plate, made by Carnegie, at Indian Head, show that these plates 10 and 11 inches thick will be equal to 15 and 18 inches of Harveyized plates, such as are carried by the "Oregon."

The improvement in train service in England is shown by the fact that in 1884 there were but seven trains making runs of 100 miles or more without intermediate stops. In 1896 it had grown to 58, and the present year it has reached 78. A complete list of these trains with their speeds was recently published in "Engineering."

The 6-inch breech-loading guns of the battleship "Oregon," of which she has four, have been replaced with rapid fire guns and her funnels have been lengthened 10 feet to improve the running under natural draught. The old slow fire 6-in. guns on the "Massachusetts" are also changed for rapid firers and her funnels have also been lengthened.

The Navy Department has decided to award bids for the purchase of 1,000,000 pounds of smokeless powder, proposals for which were opened during the first week of September. The Duponts, of Wilmington, and the California Powder Company will secure the contracts, the prices being 90 cents per pound, which is less than the prices that have been paid by the army.

Aluminum conductors are used for the first time in long-distance electric transmission in carrying the current from the Snoqualmie power plant to Tacoma and Seattle. The line to Tacoma is 47 miles long, and Seattle is reached by a 12-mile branch. The wires are Nos. 2 and 3 B. & S., the composition being aluminum 99.3 per cent., iron 0.25 per cent., silver 0.3 per cent., and this metal alloyed with 1.5 per cent. of Lake copper.

The speed of several trains on the London & Northwestern has been increased in the summer time table now in force. There are two trains between London and Liverpool, 201 miles, running at a speed of 51.8 miles per hour; five trains between London and Crewe, 158 miles, at 51.6 miles per hour; two trains between Carlisle and Crewe, 141 miles, at 52.9 miles; two from Wigan to Carlisle, at 52.6, and two from Willesden to Sheffield at 52.2 miles.

The effect of vestibules in reducing the damage to cars in wrecks was strikingly illustrated by a rear end collision on the Lake Shore August 17, in which the "limited" ran into six ice cars that were left standing on the main track near La Porte, Ind. The cars of the passenger train had wide vestibules, with the exception of the front end of the buffet car, next to the engine, and this was the only platform injured. None of the other cars was injured and no one was killed, which must be credited to the vestibules.

The proceedings of the street railway convention held in Boston, and also the character of its exhibits, seem to indicate a general tendency toward systematizing the power equipment of cars. Convertible cars attracted more than usual attention and two forms were exhibited. The "maximum traction truck" with two axles, and two trucks per car, appeared to enjoy general favor. This truck has two large and two small wheels with the load so distributed as to bring the maximum amount of weight upon the wheels that are used as drivers. Double truck cars have undoubtedly increased in favor since last year.

The report of the Commissioner of Patents for the year ending Dec. 31, 1897, records the customary increase in number of patents taken out, and in fact throughout the history of the patent office the number filed in any one year has never fallen materially below the number filed in any previous year. The number filed in 1897 exceeded by over 2,000 the total number filed in 24 years, from 1836 to 1860. The total for 1897 was 21,508, the largest numbers being by citizens of New York, Pennsylvania, Illinois and Massachusetts, in the order named. Patents granted to foreigners numbered 2,221.

Boston's subway, which was built for a little less than its estimated cost of $5,000,000, has been finished and thrown open to the use of the public. The work was begun a little less than 3½ years ago, and in its completed state comprises 1 2-3 miles of tunnel, with 5 miles of railroad track, and in furnishing the means for underground electric transit relieves a congestion in street traffic that was a great nuisance. The subway is the first underground electric road in this country, and its operation will be watched with keen interest. The commission that had charge of the improvement has made plans for a tunnel to East Boston, and has plans for several routes from which a selection is to be made.

The unarmored cruiser "Chicago," launched in 1884, has been undergoing changes at the Brooklyn Navy Yard intended to convert her into a fast cruiser of 18½ knots, developing about 9,000 indicated horse power. On her trial trip she made but 15 knots with 5,083 horse power. She is being provided with new engines and new boilers. There are to be four Scotch boilers of nickel steel, of 10½ feet in length and 13 feet 8½ inches diameter. There will also be six Babcock & Wilcox water tube boilers. Steam pressure of 180 pounds will be used. The bunker capacity is 920 tons. The ship will also be provided with the Cowles system of bulkhead doors.

The transition from day work to piece work is a critical period in most ships, and the success of piece work depends upon the manner of making the change. Mr. W. S. Rogers, in a paper before the New York Railroad Club, gives the following suggestions: "The simplest and easiest method of obtaining prices for the purposes of establishing permanent piece work rates in a shop or factory of any kind, and a practically correct cost system, is to adopt a premium method with the workmen for a few months, allowing them a fair percentage of their hour rates for the number of hours saved on their labor. When this has been carried far enough, in the judgment of those in charge, it can be abolished and piece prices put into use without any trouble whatever."

The promotion of naval officers in the form of advancement by several numbers as a reward for specially meritorious service during the war would work an indirect hardship on those who perhaps are equally worthy, but were not fortunate enough to have an opportunity to show what they could do, and it would practically degrade these men to advance the others under present rules. It would make their advance slower and in some cases prevent them from attaining their rightful grade at time of retirement. It is understood that steps will be taken to correct this injustice by legislation which will accomplish the proper promotion of those who have not had the special opportunities to distinguish themselves, and the Secretary of the Navy has already arranged to introduce a bill with this object in view.

The programme of the naval construction board, based upon recent developments, includes fifteen new warships, divided into three battleships, three armored cruisers, six protected cruisers of small size and three ships of medium size and protection. The tonnage of the battleships is to be 13,500, with a draft of 25½ feet; the minimum speed, with all stores and fuel, to be 18½ knots. The armored cruisers will have a displacement of 12,000 tons, a speed of 22 knots, and steaming radius of 10,000 knots. The armor for the battleships will be extended all over the ships; it will be 12 inches amidships, tapering to 5 inches at the ends, and made by the Harvey Krupp process. These ships will have four very long 12-inch guns in elliptical balanced sloping turrets. The whole list of ships will have water tube boilers.

In regard to the competition of electric lines, President Tuttle, of the Boston & Maine, believes that the steam roads will have to bow to the inevitable and surrender a portion of their suburban traffic. No matter, he says, how the matter may be viewed, the street railway within certain limits has now and will continue to have the advantage over the steam roads. The latter may improve their service as much as they can, but they will find eventually that they cannot compete with the trolley lines, which insure service that the steam roads cannot give, and the latter will therefore have to abandon suburban business within four or five miles of the city. They will have to develop their long-distance service, and can make improvements within a zone of from six to twenty-five miles, in addition to lowering the longer distance rates. In this way suburbs will be extended. With such an expansion and attention to through freight and passenger business the steam roads will still have an ample and profitable field of operation.

The new course in naval architecture begun last year at Annapolis under Constructor Hobson has, upon the advice of Chief Constructor Hichborn, been transferred to the Massachusetts Institute of Technology. The purpose of the change appears to be to offer the cadets the advantages that come from a complete course under a number of instructors rather than one taught by a single individual. It is a post-graduate course, and is intended to take the place of the former plan of sending the cadets abroad to the leading foreign technical schools. The final arrangements are to be made by Captain Dickens and Constructor Bowles. The course is thorough and practical, and the intention is to afford facilities second to none existing in Europe, not excepting Great Britain. The first class will have eight students, who begin work Oct. 1 for three years' training, which includes practical instruction at the shipyards and navy yards during the summer. A national distinction that is well deserved is given to this school by its selection, because the decision was made upon the recommendation of Constructor Hichborn after an examination of the facilities offered by the best schools of the country.

The engineers of the fleet that sunk Cervera's ships off Santiago were tendered a complimentary dinner by the Engineers' Club of New York, September 1, and during the evening Chief Engineer Milligan, of the "Oregon," related the experiences of the famous run by that ship around the "Horn." He paid the highest tribute to the devotion and courage of the firemen and assistant engineers, giving them the credit for the success. He spoke highly of the workmanship of the engines and boilers of the "Oregon," and the fact that no salt water leaked through the condensers and got into the boilers, showed the high grade of work done by the builders. When at Rio a dispatch told them of the departure of Cervera's fleet from the Cape Verde Islands and Mr. Milligan told of the plan that was at once arranged in the event of meeting the fleet. The "Oregon" was to start as if to run away and her high speed would string out the Spanish vessels in the order of their speed, whereupon the "Oregon" was to attack the foremost and attempt to destroy them one at a time. It was a shrewd plan and in the light of subsequent events the chances that it would succeed are very strong. The engineers earned the reception and we think that justice has not yet been done them for their important work in the war.

The percentage of hits from the gun fire of our fleet at Santiago tells better than anything else the relative values of the different guns as regards calibers and rapidity of fire. The proportion of projectiles that found their marks was only about 3 per cent., and in view of the good marksmanship this must be considered as the best that is to be expected under the severely trying conditions of naval fighting. It is made clear that rapidity of fire is vitally important. In estimating the results with reference to the small amount of damage done by the large guns, it must be remembered that the conditions did not favor the use of this armament, and that when opposed by heavily-armored vessels the high power guns are absolutely necessary. The lesson here is that every effort should be made to increase the rapidity of their fire as well as that of the smaller guns. The official report to the Navy Department analyses the hits from the guns of the United States fleet and gives the proportion of hits for each size of gun on each of the Spanish cruisers, as follows:

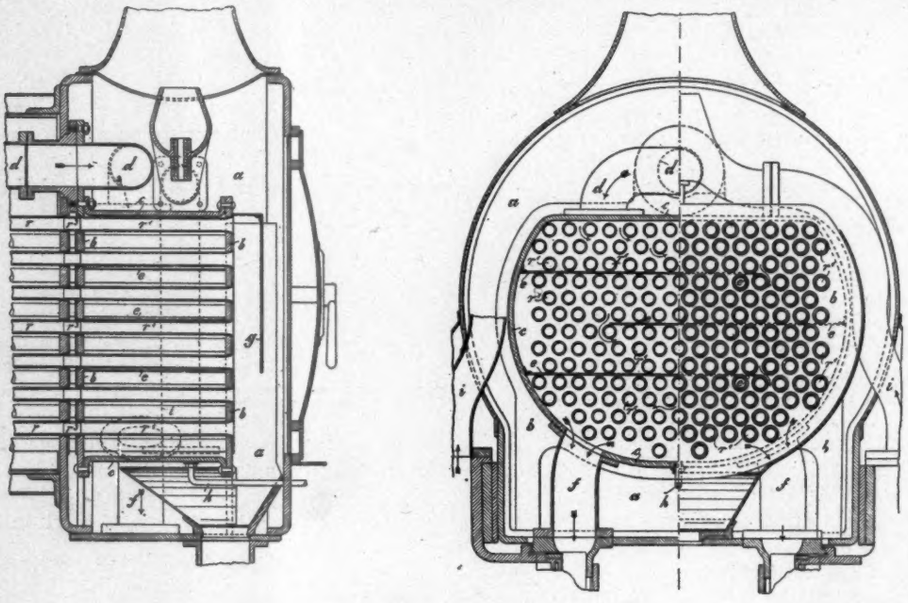
Size of gun.	Number of hits on each vessel.				Total number of hits by each caliber of gun.	Number of guns of each caliber in action	Number of hits per gun.
	Teresa.	Oquendo.	Vizcaya.	C. Colon.			
6-pounder	17	43	13	4	77	42	1 83
1-pounder	2	..	..	..	2	13	0.15
4-inch	1	7	4	..	12	3	4.00
5-inch	3	3	7	2	15	6	2.50
6-inch	1	1	..	1	3	7	0.43
8-inch	3	3	5	1	12	18	0.67
12-inch	2	..	..	..	2	6	0.33
13-inch	..	..	..	..	..	8	0.00
Totals...	29	57	29	8	123	103	..

SUPERHEATER FOR LOCOMOTIVES—A SUGGESTION.

We refer to this superheater in the above caption as "A Suggestion" because we consider it such, and it is interesting in showing how a foreign engineer has worked out the problem. Superheating would be worth while if some simple plan could be made whereby the important factors of reliability, cheapness in construction, economy in maintenance and general convenience in arrangement would be assured.

The following description is taken from the patent specifications of an invention by Mr. Jan Von Grubinski of Warsaw, Russia, the essentials of which are a superheater consisting of a drum placed in the smoke box and containing tubes which are virtually extensions of the main boiler flues. The steam on its way from the T head to the cylinders passes through this drum and around the tubes. The condensation from the steam is drained through a small tube at the bottom of the drum. The inventor describes the device as follows:

In the arrangement and details represented in Fig. 1 by a partially longitudinal vertical section and in Fig. 2 by a cross-section the boiler-tubes are connected with the tubes



A Superheater for Locomotives.

in the smoke-box by short pieces of piping r^3, so that the boiler-tubes extend a certain way into the smoke-box a. The chest arranged for the reception of the tubes r^1 consists of two plates b b, which connected with one another by means of a casing c and is in connection above with the steam-dome by means of a pipe d and below with the working cylinder of the engine by means of pipes f f.

On the side wall of the jacket or casing c are arranged the horizontal partition walls e e in such a manner that these, as may be seen from the cross section Fig. 2, leave alternately right and left a free space for the passage of the steam.

The letter g indicates a wall or partition on the front end of the boiler, which is intended to prevent a direct escape of the combustion gases issuing from the upper heating pipes or boiler-tubes r^1 into the stack, and to force the same at first downward and then, mixed with the gases from the lower heating pipes, to pass upward into the stack.

PRESSING WHEELS ON AXLES.

The best relation between the diameter of the wheel fit of axles and the bore of the wheel hub is an interesting question concerning which Mr. G. Leverich recently sent the following communication to the "Street Railway Journal":

Recently there was occasion to investigate the problem of the proper proportioning of the diameter of certain steel car-wheel hubs and axles to secure the maximum possible grip between the two, and yet have the compression of axle and the extension of bore within the elastic limits of the materials in the axle and wheel. The following was the treatment of the problem:

Let the diameter of the axle be t d and that of the wheel bore, which is of less diameter, be d x. Then the normal circumference of outer surface of axle $= \pi$ d, and of inner surface of bore $= \pi$ d x.

When the wheel is forced on the axle, d will be lessened and d x increased, so that, putting d y for the common diameter, the compression of outer surface of axle will be π d (I — y) and the extension of inner surface of bore will be π d (y — x) and per unit of length, I — y and y — x, respectively.

For per unit of length per maximum safe compression of axle material put a and per maximum safe extension of wheel material put b. Then $I - y = a$ and $-x = b$ $\therefore$ $y = I - a$ and $x = I - a - b$, and the normal diameter of axle $=$ d and the normal diameter of bore $=$ d (I — a — b.). What are the values to be given to a and b is to be determined.

It may be said that so far this discussion has dealt with the outer surface of the axle and the inner surface of the bore, which are to be brought into contact. Whether consideration of the reinforcement of the inner surface of the bore by adjacent and surrounding layers, and similarly of the axle inward, the other being outward, would affect differently the ultimate query—namely, what safe stress may be put upon the materials in the contact surface, is doubtful.

An empiric solution, probably, is a correct practical one.

Nine steel bars—g. s. m's tests.—ranging in per cent of carbon from 0.09 to 0.559; in elastic limit of tension per sq. in. from 32,540 to 43,310 pounds, and at that stress, in extension per inch from 0.00119 to 0.00161, show an average extension of 0.00129. These bars, each under 30,000 lbs. stress per sq. in. extended per inch varying from 0.00095 to 0.00108, and averaging 0.00104. Rejecting the ninth bar, having carbon 0.559 per cent., the eight remaining bars ranged in carbon from 0.09 to 0.222 per cent. in elastic limits per sq. in., from 32,540 to 37,330 pounds, and at that stress in extension from 0.00119 to 0.00132, with an average of 0.00124. Similarly these bars under 30,000 lbs. tensional stress extended per sq. in. from 0.00095 to 0.00108 with an average of 0.00103.

It may be safe to take the maximum allowable extension per unit of length at .00111 = b and compression per unit of length at one-half this, or .00055 = a.

Then d (I — a — b) = .99834 d,

which is the diameter of bore of the wheel hub, d being that of the axle; or, diameter of bore: diam. axle :: 599:600; that is for steel forged wheels and axles, the diameter of the bore of the wheel, should be one six-hundredth less than the diameter of the axle.

The largest dynamo in the world is being built by the Walker Company of Cleveland, Ohio. It is for the Boston Elevated Railway, and will have a capacity of 3,000 kilowatts at 550 volts, or about 4,000 horse power. The speed will be about 80 revolutions. Its weight is 250,000 pounds, and the diameter of the field frame is 21 feet 7 inches.

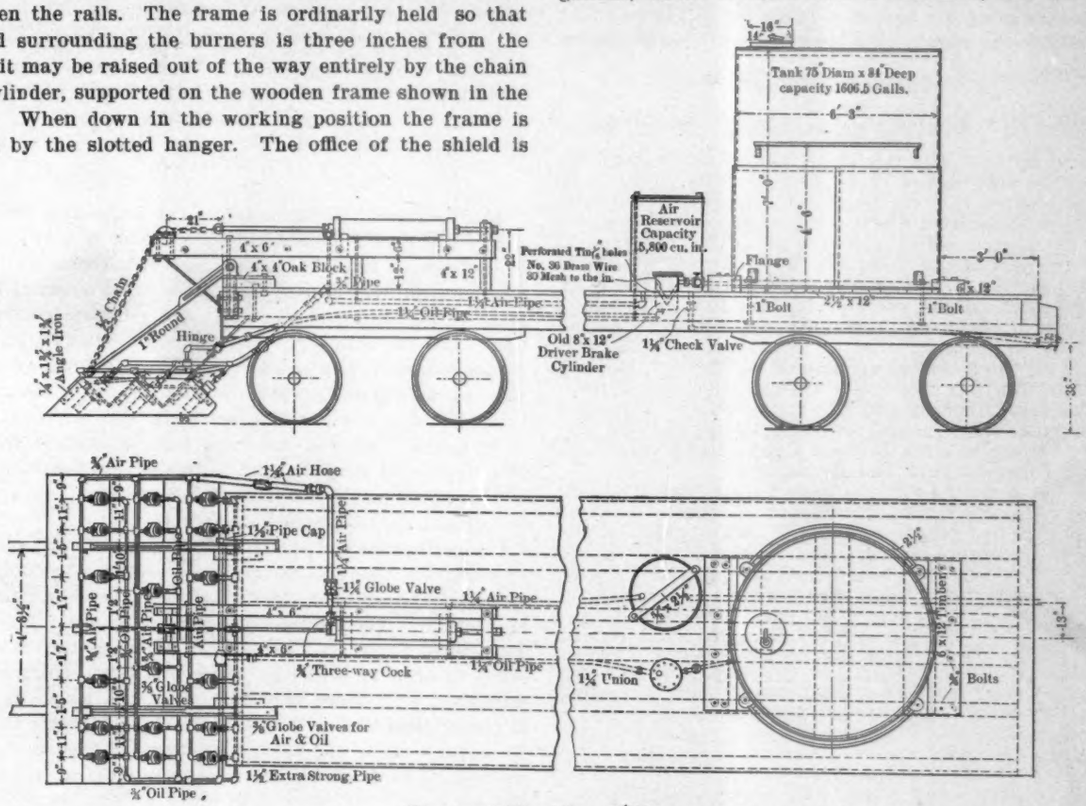
WEED BURNER—NORTHERN PACIFIC RAILWAY.

The weed burner, shown by aid of these engravings, was designed and built by the Motive Power Department of the Northern Pacific Railway, and we are informed that it burns ordinary weeds that grow along the tracks at a cost of from $2 to $4 per mile, and it will burn about 30 miles per day. The saving effected over hand labor in cutting weeds by a shovel is about $12 per mile.

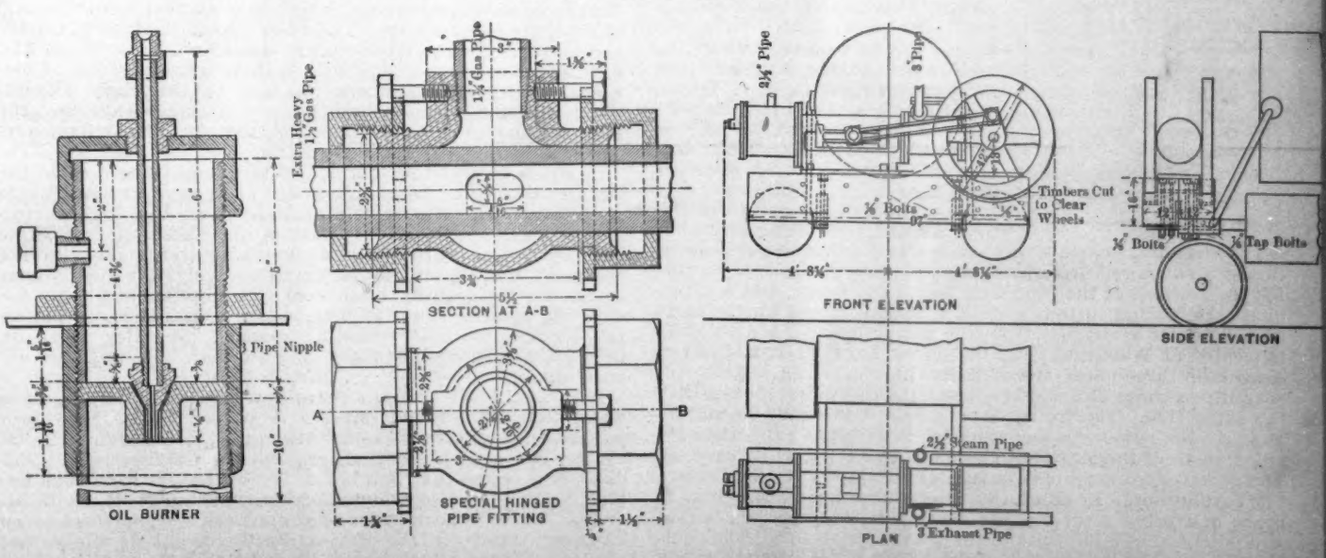
The burning outfit is carried on a flat-car, pushed by an eight wheel locomotive, that is especially detailed for this service during the season. The fuel for the burner is oil and the flame is made most effective by an air blast. There are 18 burners carried in a group on a frame hinged to the front end of the car. There are six burners outside of each rail, and six burners between the rails. The frame is ordinarily held so that the shield surrounding the burners is three inches from the rails, but it may be raised out of the way entirely by the chain and air cylinder, supported on the wooden frame shown in the drawing. When down in the working position the frame is supported by the slotted hanger. The office of the shield is to confine the heat from the burners and deflect it toward the ground, and the heat is so intense as to kill the weeds, roots and all.

The burners are made of 3-inch pipe; the construction being clearly shown in the sectional drawing. The oil comes through the tube at the center of the burner, and the air blast enters at the side and passes around the cone at the end of the oil pipe. The position of the cone may be adjusted by turning the oil tube, which is threaded where it enters the burner. The air pipe connection from the car to the burner flame is made by flexible rubber hose, but the oil pipe attachment required a packed gland joint, which was made as indicated in the views of this special fitting.

The supply of oil is carried in an iron tank, holding 1,600 gallons, which is fitted with a man-hole, and the necessary



Plan and Elevation of Car.



Details of Oil Burner and Hinge Joint. Location of Air Compressor on Locomotive.

Weed Burning Equipment—Northern Pacific Railway.

piping. The oil is passed through a strainer pot, made of an old 8x12-inch driver brake cylinder. The strainers are double, one being of tin, perforated with 1-16-inch holes, and the other is No. 30 wire netting, with 30 meshes per inch. These parts and an air reservoir complete the equipment on the burner car.

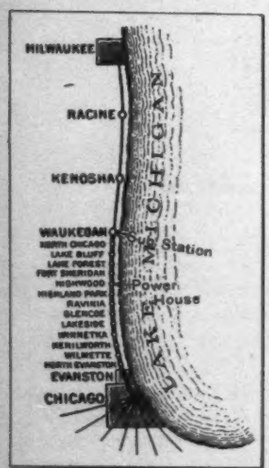
There is a check valve between the air reservoir and the end of the air supply pipe to prevent air from passing backward through this pipe in case the air supply is cut off suddenly.

There is nothing essentially new in the use of oil in this equipment or in the application of the air blast, but the use of a Rand 10x14 in. straight line air compressor in this connection is new and praiseworthy. The compressor is mounted on the front ends of the engine frames, as shown in the drawing. A 4x4 in. boiler feed pump in the cab furnishes circulating water to cool the air cylinder of the compressor, and this equipment furnishes more air and at a much lower expense than the eight air brake pumps that were formerly used for the same purpose.

THE CHICAGO & MILWAUKEE ELECTRIC RAILWAY.

An electric railway, 85 miles long, connecting Chicago and Milwaukee, has been talked of for several years, and it now seems to be assured that the project will be carried through. The Chicago & Milwaukee Electric Railway Company has the franchise for a line between Evanston and Waukegan, 31 miles, and the part of this from Highland Park to Waukegan was put into service in July, and it is expected that the rapid work on the southern end will complete the line to Evanston before the end of October. The lines of the North Chicago Street Railway will connect with it at Evanston, and also passengers may use the Evanston division of the Chicago, Milwaukee & St. Paul Railway and the Northwestern Elevated Railway into Chicago. Kenosha and Milwaukee are now connected by a line 33 miles long, running through Racine, and the only gaps to be filled are 16 miles between Kenosha and Waukegan and between Highland Park and Evanston.

The route lies along the shore of Lake Michigan and through about fifteen cities and towns, the effect to be expected being to greatly reduce the passenger business of that division of the Chicago & Northwestern Railway that lies just west of the electric line, except north of Chicago, where the tracks of the electric road pass through subways under the Chicago & Northwestern and the Elgin, Joliet & Eastern Railways. There are to be no crossings with steam roads at grade. The fares are expected to be about half those of the Chicago & Northwestern for corresponding distances.



The road is at present a single track line, with sidings, but will probably be double-tracked next year. The line, except for a distance of about 8 miles, follows the highways, and the 8 miles is an independent right of way, fenced in. The rail is of 65 and 72-lb. "T" and "Shanghai" sections, laid on ties in slug and broken stone ballast. The work is being done by C. E. Loss & Co., of Chicago, contractors, under the direction of Mr. B. J. Arnold, Consulting Engineer.

The electrical distribution system was planned to save copper in the conductors. It employs a combination of direct current for the sections of the road near the power house, and a three-phase alternating current system, with substations for the parts of the line at a distance from the power house. A substation is located at Waukegan, and the power house is at Highwood. An 8 mile three-phase transmission line, carrying a 5,500-volt current on three No. 8 wires, connects the power house with the substation. The trolley wire is No. 00 from the substation and a No. 0000 feeder extends 4 miles south and 3½ miles north of the station. There are two types of generators. The three-phase machines have a capacity of 250 kilowatts at 125 revolutions. Each of the alternating generators has 24 poles, delivering a three-phase current of 25 cycles per second at a potential of 5,500 volts to the transmission line. The combination generators are also of 250 kilowatts capacity, running at 125 revolutions, and the current may be either direct or three-phase. There is but one armature, but the windings are connected on one side to a commutator, and on the other side to collector rings. The direct current is of 600 volts, and the three-phase current 380 volts. The low voltage is raised to 5,500 when sent to the substation by means of transformers in the basement of the power house. The "Arnold system" of connecting engines and generators is used, being a great improvement on the ordinary direct connected plan. When the line is completed the substations will have step-down transformers, a rotary converter and a storage battery. A part of the plan is to mount the machinery needed for a substation upon a car fitted with motors, so that it may be sent out to a substation for use in case of break-downs, and before the arrival of the portable substation outfit the storage battery may be relied on to keep the cars moving. The cars will have 35 H. P. motors for the four-wheel type and 50 H. P. motors for the eight-wheel type, and the larger cars are expected to attain full speed of 30 miles per hour in 19 seconds. Ten cars are now in use.

A great deal of attention has been paid to the steam plant. Steam will be furnished by six 250 H. P. Cahall-Babcock & Wilcox water-tube boilers, with Hawley down-draft furnaces, three of which are now in use. They are fed by the Q & C Company's apparatus, recently illustrated in our pages, and there is to be a fuel economizer for each pair of boilers.

WATER TUBE BOILERS ON THE U. S. GUNBOAT "MARIETTA."

The wonderful performance of the battleship "Oregon" has had a great deal of attention, but much less has been given to the equally brilliant performance of her consort, the "Marietta," on the trip around the "Horn." This vessel is 174 feet long, 34 feet beam, 12 feet draft and the displacement is 1,000 tons. She has twin screw engines, with cylinders 12, 18 and 28 inches diameter, and 18 inches stroke. The boilers are by the Babcock & Wilcox Company, and are 11 feet 6 inches long by 9 feet 6 inches wide, and 11 feet high. The total grate surface is 94 square feet, and the total heating surface 3,620 square feet. The total weight of the boilers is 94,016 pounds, complete with heaters, and with water and all fittings and attachments the weight is 112,000 pounds.

The performance of this vessel was due chiefly to the boilers. The trip was made as far as Rio de Janeiro in company with the "Oregon," and the "Marietta" proceeded alone for the rest of the way. The contract guarantee for the "Marietta" was but twelve knots, and as she had to make thirteen knots in order to keep up with the battleship, the performance is remarkable, even more so than that of the larger ship. Chief Engineer Melville has long been in favor of water tube boilers for naval vessels, and this experience will tend to confirm his position. The vessel was not delayed a moment by her boilers, and no repairs were made to them during the trip. It may therefore be said that these boilers came through this long voyage in perfect condition, which is more than could be said of other forms of boilers. The vessel has been in service since her arrival at Key West, which should convince those who have not favored this type that their position is weak. Chief Engineer W. H. Chambers reported to the Navy Department upon the trials preliminary to the long voyage, and the total consumption of fuel, including that for all auxiliary purposes, is remarkably low. He said:

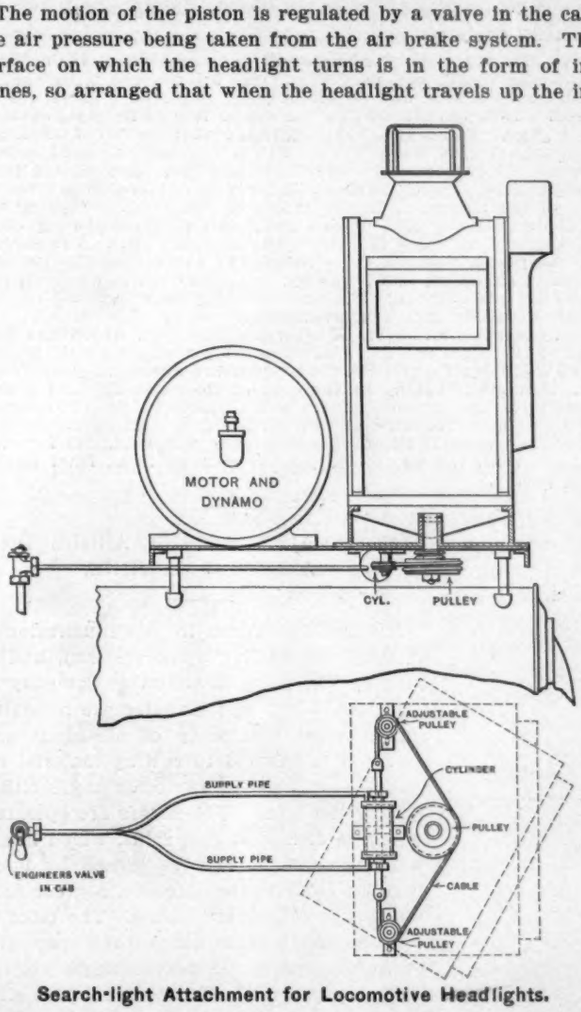
"Runs were made for periods of forty-eight hours each, the engine revolutions being maintained at as near a constant rate as possible, and a careful account kept of the distance run and the amount of coal burned during these times. Three different rates of revolutions of engine were taken, giving speeds of 10½, 9½ and 8½ knots respectively. At the 8½-knot speed the wonderfully small coal consumption of 6½ tons a day was obtained, or 1.52 pounds per indicated horse power. In other words, the "Marietta" steamed 264 miles a day on only 6½ tons of coal, or could go more than 7,500 miles on her coal supply."

It is significant that the three new battleships are to have water tube boilers, and Babcock & Wilcox boilers have been put into the "Chicago" and "Atlanta." In a communication by Mr. James H. Rosenthal, printed by "Engineering" (London), it is stated that Babcock & Wilcox boilers have been applied to upward of 60 ships, and among them H. M. S. "Sheldrake," which is soon to go into commission. There are seven of these vessels in the United States navy. Mr. Rosenthal also gives interesting figures from tests on S. S. "Otto" and S. S. "Rollo," in which the pounds of coal per indicated horse power per hour were 1.5 and 1.6 respectively.

SEARCH-LIGHT ATTACHMENT TO LOCOMOTIVE HEADLIGHTS.

An arrangement for turning locomotive headlights on a vertical axis for the purpose of throwing the light upon the tracks on curves, designed and patented by Mr. John S. Thurman, Mechanical Engineer of the Missouri Pacific Railway, is illustrated in the accompanying engraving. The drawing shows an electric headlight with the motor and dynamo mounted together on a table, on the under side of which the turning mechanism is secured. The headlight is mounted on a turntable, which is rotated through the proper angle by a cable passing around pulleys and leading to the two piston rods of a 2¼-inch double-acting air cylinder.

The motion of the piston is regulated by a valve in the cab, the air pressure being taken from the air brake system. The surface on which the headlight turns is in the form of inclines, so arranged that when the headlight travels up the incline it will have bearings on the two quarters on which it travels. The object of this is to return the headlight to its normal position automatically when the air is released. The device has been tried on three Western roads, and the enginemen like it. They say that they can see ahead as well on curves as on straight track. It is equally well adapted to headlights using oil.



Search-light Attachment for Locomotive Headlights.

MASTER MECHANICS' ASSOCIATION, COMMITTEES FOR 1899.

The subjects for report at the next convention of the Master Mechanics' Association and the members appointed on the committees have been selected by the Executive Committee and are as follows:

1—A Research Laboratory Under the Control of the Association.—Wm. Forsyth, W. F. M. Goss, John Player.

2—The Best Methods of Preventing Trouble in Boilers from Water Impurities.—A. E. Manchester, J. H. Manning, S. P. Bush, H. Bartlett, R. M. Galbraith.

3—Relative Merits of Cast-Iron and Steel-Tired Wheels for Locomotives and Passenger Car Equipment.—J. N. Barr, H. S. Hayward, A. M. Waitt.

4—Advantages of the Ton-Mile Basis for Motive Power Statistics.—H. J. Small, C. H. Quereau, W. H. Marshall.

5—Best Method of Applying Stay Bolts to Locomotive Boilers, Including Making the Bolts and Preparing the Stay Bolt Holes.—G. F. Wilson, S. M. Vauclain, T. A. Lawes.

6—Is It Desirable to Have Flanged Tires on All the Drivers of Mogul, Ten-Wheel and Consolidation Engines? If So, with What Clearance Should They Be Set?—S. Higgins, W. H. Thomas, Wm. Garstang.

7—Best Form of Fire Box to Prevent Cracking. Is It Advisable to Use One Piece for Crown and Side Sheets? H. Monkhouse, T. R. Browne, B. Haskell.

8—The use of Nickel Steel in Locomotive Construction; Its Advantages and Proper Proportion of Nickel.—A. E. Mitchell, Pulaski Leeds, Tracy Lyon.

9—Subjects, R. Atkinson, John Hickey, G. R. Henderson.

EXAMINATION OF EMPLOYEES.

In self defense railroads ought to exercise great care in the selection of men to secure those who are physically and mentally qualified for their duties. The rigidity of the physical examination for enlistment in the army and navy has been criticised, but now that the war is over the justification of the severity is apparent.

Railroads have the same reasons for selecting men who are up to a high health standard and who are properly qualified mentally. They have, indeed, more reason for care than the Government, because a road is liable for the damage caused by ignorant or incompetent men, yet the proceedings of the last meeting of the Association of Railroad Surgeons show that neglect of proper precautions is very common. This may work a hardship upon an occasional individual, but the benefit of the many demands the most careful selection of men for such responsible work. If it is important to select the material for the construction of road and rolling stock and test it for imperfections, it appears to be at least equally important to use the same degree of care in selecting men.

The Chicago, Rock Island & Pacific Railway has set an example in this respect by requiring physical examinations very much like those of the military service. We have a copy of the blank application for employement, and it combines searching questions for the applicant to answer, including his education, record of service and experience, with a blank certificate for the surgeon's examination. The latter includes vision, color sense and hearing records, and has charts showing the skeleton for the purpose of locating deformities. Otherwise it strongly resembles a life insurance blank.

This blank is used for applicants for employment as agents, operators, station baggagemen, engineers, firemen, engine dispatchers, conductors, switchmen and all who have to do with the handling of trains. The candidate's portion is filled out and the applicant reports to the nearest company's surgeon for the sight and hearing test; then, if he desires to enter train or switching service, he is subjected to the physical examination. The surgeon making the tests and examination reports on the application blank, and sends one copy to the division superintendent or the master mechanic and another to the chief surgeon. Reading and writing are required of all candidates, and the applicant's history for the previous five years must be given, special reference being made to any railroad service and the reasons for leaving it. The paper is complete, and its use must insure the possession of knowledge necessary to deciding upon the desirability of the candidate.

ANOTHER WESTINGHOUSE LONG-DISTANCE TRANSMISSION PLANT.

Contracts involving ten thousand horse power are not common. Especially is this true when the agreement is to transmit this enormous amount of power over a distance of 45 miles. And when the contract further stipulates that the losses in generators, transformers and line shall remain normal, notwithstanding the difficulties involved, the agreement then becomes of still greater interest.

Such a contract has just been executed by the Westinghouse Electric & Manufacturing Company, in which they agree to comply with the above conditions. The plant is for the Snoqualmie Falls Electric Power Co., of Snoqualmie Falls, Washington.

The power station is to be located at Snoqualmie Falls, 45

miles from Tacoma and 31 miles from Seattle, to which places the current is to be transmitted, and then utilized by Westinghouse motors.

The contract involves the building and delivery at above points of four three phase, rotary armature generators, having a normal aggregate capacity of 6,000 kilowatts, and which are to be direct connected to water wheels; two 75 kilowatt kodak exciter dynamos, also to be direct connected to water wheels; high and low potential switchboards, for main power station and sub-stations at Seattle and Tacoma, involving 76 marble panels with all necessary instruments, switches, etc.; high tension oil insulated static transformers, having an aggregate capacity of 10,875 kilowatts; rotary transformers with a total output of 2,700 kilowatts and 6 type "C" motors developing 1,600 horse power, with adequate lightning protection at both ends of the line.

These machines, when installed, will make the power of Snoqualmie Falls available for industrial, railway and lighting purposes. The line potential will be 25,000 volts, and its current will be carried over bare aluminum wires to sub-stations, where lowering transformers will reduce the voltage sufficiently for safe transmission within the corporate limits of the two cities.

TIE PLATES RECOMMENDED BY ROADMASTERS' ASSOCIATION.

At the convention of the Roadmasters' Association held in Denver the Committee on Tie Plates presented an interesting and valuable report, from which we quote the following opinions and recommendations:

Considering the cases which have come under the personal observation of this committee in connection with the answers to inquiries which we have sent out to many experienced railroad men who have used the various types of tie plates, we submit recommendations as to the general construction and use of tie plates, together with the facts and general information from which we have drawn these recommendations:

Recommendations.

First—That tie plates be used always in preference to rail braces for greater safety and higher economy.

Second—That tie plates be used on all ties where the life of the tie is limited by the cutting or sawing action of the rail.

Third—That tie plates be used on all ties whose life is limited on account of the destruction caused by spike killing.

Fourth—That tie plates with soft ties be used in preference to hard ties without any plates, when the natural life of the soft tie is equal to or greater than the natural life of the hard tie, cost being equal.

Fifth—That the only plate used be one which becomes practically part of the tie.

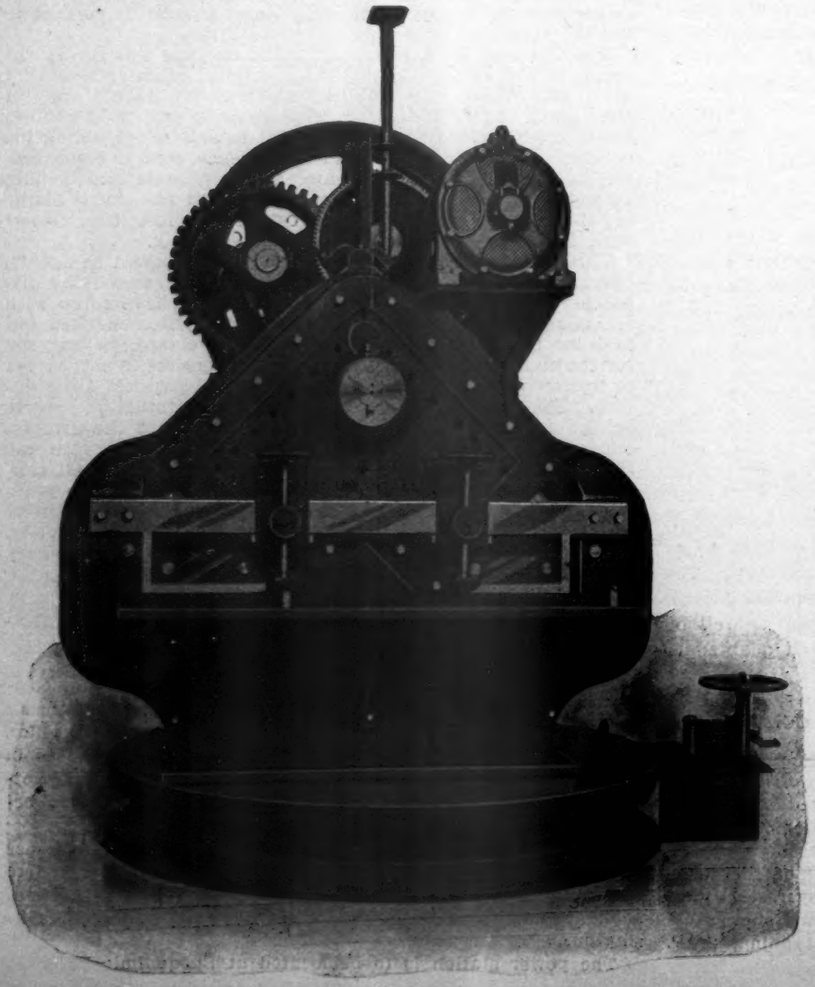
Sixth—That as a tie plate is intended to prevent the cutting action of the rail flange across the wood fibers of the tie, the plate used should not itself cut such fibers and should prevent the rail from cutting them.

Seventh—That a tie plate having sufficient thickness to resist buckling, sand wear and rust, during the natural life of the tie, should be used.

In connection with the records of experience with tie plates a number of reports were presented, among which two are quoted as follows:

An old, experienced roadmaster, who has about 70,000 Servis plates in track, has used them on "2½ degrees with oak, on cedar switch sets, and on center joint ties, where three ties are used." He applies them "by the aid of Ware's tie plate surfacer and gage," and cost of applying is ½ cent inties out of track and less than 1 cent when ties are in track. Oak ties used in both cases. He uses them on every tie, and finds they do not move longitudinally, and does not know which plate lengthens the life of the tie most. Under "remarks" he says: "Having had 45,000 in use since 1892, on oak ties and on curves of 5 degrees to 7½ degrees, have not had to regage any part of it. The surface of the plates has not gone below the surface of the tie, and work of surfacing and regaging, caused by the rail cutting into the ties, has been entirely eliminated by their use. As an element of safety they are invaluable."

An engineer, M. of W. of a large traffic line, which has been one of the most extensive users of tie plates for years, writes: "We have been using Servis tie plates for several years past. . . . A great saving in the cost of tie renewals, and consequently in the expense of track maintenance, will be secured by their use. The kind of ties particularly used by us are redwood, the natural life of which (under heavy traffic) is seven years. With the use of tie plates we hope to at least double this period."



Angle Shears, Long & Allstatter Co. Driven by Type "C" Tesla Motor.

ELECTRICALLY DRIVEN ANGLE IRON SHEARING MACHINE.

The machine shown in this illustration is designed for cutting up angle iron, and is built by The Long & Allstatter Company of Hamilton, Ohio, who manufacture punching and shearing machinery of all kinds and sizes. It is adapted to cutting material off square, at mitre or at any other angle, either right or left hand. The shears are operated by means of a steel cam shaft, which is arranged so that it may be turned by hand from the front of the machine, a great convenience in setting the blades. The table is of iron, and is provided with a gage for setting the bar to the desired angle. Hold-down screws on the front of the machine hold the bar down and prevent it from tipping up as the knife comes down. An automatic stop movement brings the machine to rest with the shears open, thus permitting the accurate adjustment of the bar to be cut. The machine is mounted on a patent revolving table, so that it can be turned either to the right or the left, and accurately set to the desired angle to which the bar is to be cut, without moving the bar from its normal position when being cut off at a right angle.

The illustration shows the machine driven by a Tesla polyphase motor, made by The Westinghouse Electric & Manufacturing Company, of Pittsburgh, but can be furnished with steam engine attacned, in both cases the machine being independent of shafting. If desired it may be arranged with tight and loose pulleys and driven by

belt. These machines are also made with independent shafts and slides, or in any other form that is found desirable. The manufacturers build seven different sizes of this machine, the smallest being adapted for shearing up to 3 by 3 by ⅜ inch angles, while the largest is snitable for shearing the heaviest sections.

THE BARTOW BELL RINGER.

The Chicago Pneumatic Tool Company has just placed a simple pneumatic bell ringer upon the market which appears to have advantages over others that we have seen. As shown by the engraving, it is very simple and has few parts, which should result in good wearing qualities, and low expense for repairs. The device has been in successful use for about two years on several Eastern roads, and no repairs have been required in this time.

There is no direct connection between the bell and the motor operating it. The cylinder, which operates by compressed air, is carried on a bracket bolted to the bell frame. The piston rod carries a disc at its upper end which operates the bell by means of a roller on the end of the bell crank. The valve is moved by a rod having two tappets and is controlled by an arm extending from the piston rod of the ringer. The tappets are in the form of adjustable nuts, whereby the length of stroke and rapidity of operation are adjusted. The claims urged for this ringer are simplicity, ease of attachment and economy in operation. The cylinder takes air from the main reservoir on the engine, and as the stroke of the piston is very short, and the diameter of the cylinder is only 1¼ inches, very little air is used. In fact, the amount consumed cannot be noticed in the operation of the engine. The company referred to states that it has been shown that one of these engines saved enough fuel to pay for its cost in a single month, because of leaving the fireman free to attend to the fire instead of watching for crossings. The ringer is controlled by a valve in the cab. Bell ringers are commonly used in large sections of the country, and we believe that once adopted they are never discarded.

The Bartow Bell Ringer.

LUXURY IN SIBERIA.

The new Siberian train which was recently sent to St. Petersburg for the approval of Prince Hilkof, Minister of Ways and Communications, returned to Moscow, after being personally inspected by the Czar. This is the second train specially built for the quick service on the Great Siberian Railway. It is, says the Moscow correspondent of "The Standard," an improvement on the first specially built train, which was a marvel to Russians. The new train consists of five coaches, two for second-class and one for first-class passengers; the others are a dining and a baggage car. The construction is of the newest design, and the train runs with great smoothness. Besides the comforts of a bathroom with gymnastic apparatus, a library of books in several languages, a piano and selections of music, maps, guide books, albums of views, an ice cellar, and an arrangement for boiling water in three minutes by means of steam, which were found in the first train, the new one is fitted with plates which indicate the next stopping station, and, if the stoppage be over five minutes, also how long the train stops.

All the windows are protected from dust and wind by external plate-glass guards; the last coach is arranged to serve as an "observation car," showing views of the country traversed. A stationary bicycle, with arrangements for measuring in minutes and kilometers the amount of work done; a barber, who is qualified to give medical assistance, and a superintendent who speaks Russian, French, German and English, are among the other conveniences to comfort of traveling now provided. The train will be lighted inside and out by electricity, and electric cigar lighters find a place in the dining car. A laboratory has been fitted in the second-class car, so as to be available for the enthusiastic photographer to change plates and develop them during the journey. Electric bells and portable electric reading lamps are in each compartment. The kitchen is intended to furnish a hot dinner for a maximum of sixty people. Paper and envelopes are to be supplied gratis at the buffet, where hot and cold drinks of all kinds are to be had; there is no charge for the barber, but two rubles is the price for a bath, for which three hours' notice beforehand must be given.

CHEAP RAILWAY RATES IN SWITZERLAND.

Railway traveling in Switzerland has, since June 1, undergone quite a revolution in the delivery of tickets and their extraordinary cheapness. A great blow has been given by the railway administration to the formerly advantageous tourist or circular ticket.

The following is the series of tickets delivered at all the most important stations at a couple of hours' notice and at all small stations at twenty-four hours' notice:

Tickets for one person, valid for—	1st Class.	2d Class.	3d Class.
15 days..	$11.58	$8.11	$5.79
30 days.....	19.30	13.51	9.65
3 months	46.32	32.81	23.16
6 months.....	73.34	51.11	36.67
12 months.....	115.80	81.06	57.90

These new tickets enable the holder to travel as much and as long as he likes over the entire railway system of Switzerland during the time of the validity of his ticket. The lake steamers are also available, a second-class railway ticket giving the right to a first-class ticket on the steamers. These tickets are rigorously personal, and have attached to them a photograph of the holder. Tickets must be signed with the holder's entire name. An extra sum of 5 francs (97 cents), has to be paid upon delivery, which, however, is returned when the ticket expires. The duration of these tickets cannot be prolonged. No luggage is allowed free, and no allowance is made for tickets unused.

M. C. B. COUPLERS—WEIGHTS AND MANUFACTURERS.

We are often asked for addresses of coupler makers, and a list of the Master Car Builders' couplers, with weights of the parts and the names and addresses of the manufacturers will be convenient for reference. This list was prepared by Mr. John W. Cloud, Secretary of the Master Car Builders' Association, and sent out to members in the form of a circular, in accordance with a recommendation of the Committee on Prices. The list is as follows:

American Coupler.—American Coupler company, 1413 Fisher building, Chicago, Ill. Bar, 160 pounds; lock, complete, 9 pounds; pin, 5 pounds; knuckle, 46 pounds.

Buckeye Coupler.—The Buckeye Malleable Iron & Coupler company, Columbus, Ohio. Drawhead, for freight cars, 156 pounds; drawhead, with 6-inch shank, for freight cars, 166 pounds; drawhead, with long shank, for passenger cars, 160 pounds; knuckle, 46 pounds; lock, 7 pounds; lock link, ⅞ pound; pivot pin, 5 pounds; pivot pin for safety attachment, 10 pounds.

Burns Coupler.—Syracuse Malleable Iron Works, Syracuse, N. Y. Drawhead, 151½ pounds; knuckle, 45½ pounds; lock, 6¾ pounds; pin, 4¼ pounds; pivot pin, 5¾ pounds; knuckle opener, 1¾ pounds.

Chicago Coupler.—Latrobe Steel & Coupler company; office, Old Colony building, Chicago, Ill.

Freight Car Coupler: Drawbar, steel, 156 pounds; knuckle, steel, 54 pounds; locking arm, steel, 9 pounds; pivot pin, steel, 6 pounds; lifting pin, steel, 3 pounds.

Passenger Car Coupler: Drawbar, steel, 190 pounds; knuckle, steel, 55 pounds; locking arm, steel, 9 pounds; pivot pin, steel, 6 pounds.

The weight of the Chicago coupler varies with the type of shank used:

Drawbar for M. C. B. standard strap attachment weighs.154 lbs.
Drawbar for M. C. B. tail-bolt attachment weighs.....156 "
Drawbar for M. C. B. combination shank weighs.....155 "
Drawbar for M. C. B. Amer. continuous draught weighs.162 "

Columbia Coupler.—Latrobe Steel & Coupler company; office, Old Colony building, Chicago, Ill. Drawbar, steel, 175 pounds; knuckle, steel, 43 pounds; locking pin, steel, 8 pounds; pivot pin, steel, 6 pounds.

Detroit Coupler.—Michigan Malleable Iron company, Detroit, Mich. Shank, 160½ pounds; knuckle, 47¾ pounds; lock, 8 pounds; lock lifter, 1½ pounds; pivotal pin, 7¼ pounds; lock rivets, ½ pound; clevis and pin, 1 pound.

Drexel Coupler.—Drexel Railway Supply company, Rookery building, Chicago, Ill. Body, 135 pounds; knuckle, 52 pounds; lock, 10 pounds; fulcrum pin, 5 pounds; clevis, 1 pound.

Elliott Coupler.—The Elliott Car company, Gadsden, Ala. Coupler skeleton, malleable, 182 pounds; lock, malleable, 5½ pounds; knuckle, steel, 41 pounds; spring, steel, 11-16 pound; pin, wrought-iron, 5 pounds; lift, wrought-iron, 1 pound.

Erie Coupler.—Erie Malleable Iron company, limited, Erie, Pa. Coupler body, malleable, 150 pounds; knuckle, steel, 52 pounds; lock, malleable, and chain, steel, 15 pounds; knuckle pin and lock pin, steel, 6¾ pounds.

Forsyth Coupler: Ross-Meehan Foundry Company, Chattanooga, Tenn. Shank, malleable, 150 pounds; lock, malleable, 4 pounds; lock lever, malleable, 5 pounds; knuckle, steel, 49 pounds; knuckle pin, steel, 8 pounds.

Gallager Coupler.—Gallager Coupler & Unlocking Attachment company, Savannah, Ga.

Freight Coupler: Coupler head, malleable, 157 pounds; knuckle, cast-steel, 38½ pounds; locking dog, malleable, 4½ pounds; unlocking pin, malleable, 1 pound; knuckle pin, iron or steel, 5 pounds.

Passenger Coupler: Coupler head, malleable, 162 pounds; knuckle, cast-steel, 38½ pounds; locking dog, malleable, 4½ pounds; unlocking pin, malleable, 1 pound; knuckle pin, iron or steel, 5 pounds.

Gould Coupler.—Gould Coupler company, 66 Broadway, New York.

Freight Coupler: Head, 175 pounds; knuckle, 38 pounds; knuckle pin, 8 pounds; lock pin, 1 pound; knuckle lock, 8 pounds; chain, 2 pounds.

Passenger Coupler: Head, 209 pounds; knuckle, 38 pounds; knuckle pin, 8 pounds; clevis, 1½ pounds; nut, ½ pound; lock, 8 pounds; lock link, 2 pounds; lock staple, ½ pound; spring stems, 1½ pounds; springs, ½ pounds; lock pin, 1 pound; clevis pin, ½ pound.

Hien Coupler.—The Railroad Supply company, Owings building, Chicago, Ill.

Freight Coupler: Shank, malleable, 135 pounds; shank, steel, 140 pounds; knuckle, 42 pounds; other parts, 22 pounds.

Hinson Coupler.—Hinson Manufacturing company, Gaff building, Chicago, Ill. Drawbar head, 160 pounds; knuckle, 50 pounds; lock, 7 pounds; hangers, 3 pounds.

Janney Coupler.—The McConway & Torley company, Pittsburg, Pa.

Freight Coupler: Coupler casting, 179 pounds; wrought knuckle, 37.5 pounds; knuckle pin, 5.5 pounds; locking pin No 96, wrought-iron, fitted, 10.5 pounds; release lever keeper, 1.6 pounds; release lever lock, 2.4 pounds; release lever angle, clips and bolt, 1.5 pounds; clevis and pin, fitted, ½ pound.

Passenger Coupler: Coupler casting No. 1, 154 pounds; coupler casting No. 1-P, 158 pounds; Janney-Buhoup coupler casting No. 1-J-B, 148 pounds; Janney-Buhoup coupler casting No. 1 J-B-P, 151 pounds; knuckle, No. 2-B, 37½ pounds; knuckle pin No. 16, 5¼ pounds; catch No. 3, 5 pounds; horn No. 130, 2 pounds; catch lever No. 22, 7½ pounds.

Little Delaware Coupler.—Wilmington Malleable Iron company, Wilmington, Del. Shank, 144 pounds; knuckle, 50 pounds; hinge pin, 5 pounds; lock, 5 pounds; lever, shackle and pin, 1½ pounds.

Lone Star Coupler.—The Franklin Steel Casting company, Franklin, Pa. Shank, 160 pounds; knuckle, 50 pounds; lock and link, 10 pounds; pin, 6 pounds.

Ludlow Coupler (Class A).—Springfield Malleable Iron company, Springfield, Ohio.

Freight Coupler: Bar or shank, malleable, 140 pounds; knuckle, steel, 61 pounds; locking pin, steel, 6.8 pounds; hinge pin, steel, 6.8 pounds; locking pin clevis, malleable, 0.1 pound; annulus, malleable, 1.3 pounds.

Mather Coupler.—A. C. Mather & Co., 1320 Marquette building, Chicago. Drawbar, malleable, 165 pounds; drawbar lock, malleable, 7 pounds; knuckle, steel, 36 pounds; knuckle pin, wrought, 5 pounds.

Missouri Pacific.—American Steel Foundry company, St. Louis, Mo. Shank, cast-steel, 176 pounds; knuckle, cast-steel, 50 pounds; lock, cast-steel, 10 pounds; hinge pin, wrought-steel, 6 pounds.

Murphy Coupler.—The Marion Car Coupler company, Marion, O. Coupler body, malleable, 138 pounds; knuckle, steel, 48 pounds; knuckle pin, steel, 5 pounds; lock, malleable, 7½ pounds; lock pin, malleable, 1½ pounds.

National Coupler.—National Car Coupler company, Monadnock building, Chicago, Ill.

Freight Coupler G-1: Coupler, all steel, stem or bar, 146 pounds; knuckle G-2, 44 pounds; lock G-3, 9½ pounds; pivot pin, 5½ pounds

Freight Coupler A-1: All steel; bar, 143 pounds; knuckle A-2, 44 pounds; lock A-3, 9½ pounds; lock pin A-4, 2½ pounds; unlocking lever A-5, 3½ pounds; pivot pin, 5½ pounds.

Perfected Freight Coupler: All steel; bar No. 1, 150 pounds; No. 2 knuckle, 50 pounds; lock No. 3, 9 pounds.

(The National A-2 and Perfected are not manufactured now, except the supplies, G-1 being standard freight coupler.)

National Passenger Coupler: All steel; bar No. 5-P, without wrought-iron extension, 192 pounds; M. C. B. knuckle No. 2-P, 44 pounds; lock No. 3-P, 10 pounds; side unlocking lever No. 4½-P, 4 pounds; bottom unlocking lever No. 4-P, 4 pounds. When this coupler is used as Miller M. C. B. combination, add 68 pounds for Miller knuckle to No. 8-P.

New York Coupler.—New York Coupler company, 120-122 Liberty street, New York. Shank, 155 pounds; knuckle, 53 pounds; hinge pin, 9 pounds; lock, 4 pounds; lock lever, 1 pound; lock pin, ½ pound; shackle and pin, ½ pound.

Peerless Coupler.—Peerless Coupler company, 20 Broad street, New York. Shank, malleable, 140 pounds; knuckle, steel, 39 pounds; knuckle pin, steel, 7 pounds; lock, wrought, 4 pounds; lifting lever, wrought, 3 pounds.

Pooley Coupler.—Pratt & Letchworth company, Buffalo, N. Y. Barrel, 159 pounds; knuckle, 38 pounds; dog, 9 pounds; kicker, 4½ pounds.

S., H. & H. Coupler.—Shickle, Harrison & Howard Iron company, St. Louis. Mo. Shank, 165 pounds; knuckle, 51 pounds; knuckle pin, 6 pounds; knuckle lock, 14 pounds; knuckle opener, 3 pounds.

Smillie Coupler.—The Smillie Coupler & Manufacturing company, Newark, N. J. Shank, malleable, 150 pounds; knuckle, steel, 55 pounds; No. 8 locking pin, 7 9-16 pounds; No. 9 pivot pin, 4 11-16 pounds; lifting chain, clevises, etc., 1 7-16 pounds.

Smith Coupler.—American Steel Foundry company, St. Louis, Mo. Shank, cast-steel, 150 pounds; knuckle, cast-steel, 47 pounds; lock, cast-steel, 10 pounds; lock lift, cast-steel, 2 pounds; hinge pin, wrought-steel, 6 pounds.

Solid Coupler.—Michigan Malleable Iron company, Detroit, Mich. Shank, 154 pounds; knuckle, 49½ pounds; lock, 9¼ pounds; pivotal pin, 7¼ pounds; lock-retaining pin, ½ pound; clevis and pin, 1 pound.

Standard Coupler.—Standard Coupler company, 26 Cortlandt street, New York.

Improved Standard: Drawhead, malleable, 140 pounds; knuckle, forged-steel, 66 pounds; locking pins, forged-steel, 7½ pounds.

Standard: Knuckle, cast-steel, 55 pounds; locking pins, forged-steel, 10½ pounds.

St. Louis Coupler.—St. Louis Car Coupler Co., St. Louis, Mo. Drawbar, steel, 143 pounds; knuckle, steel, 54 pounds; locking pin, steel, 6 pounds; pivot pin, steel, 5 pounds.

Talbot Coupler.—American Steel Foundry company, St. Louis, Mo. Shank, cast-steel, 176 pounds; knuckle, cast-steel, 50 pounds; lock, cast-steel, 10 pounds; hinge pin, wrought-steel, 6 pounds.

Thurmond Coupler.—I. G. Johnson & Co., Spuyten Duyvil, New York city. Drawhead, malleable, 143 pounds; knuckle, steel, 47 pounds; lock, steel, 10 pounds; pivot pin, wrought-steel, 5 pounds.

Tower Coupler.—The National Malleable Casting company, Cleveland, O.

Freight Coupler: Coupler head, 145 pounds; knuckle, 53 pounds; lock, 10 pounds; pivot pin, 6½ pounds; chain, 1¾ pounds; clevis, ¾ pound.

Trojan Coupler.—The Trojan Car Coupler company, Troy, N. Y.

Freight Coupler: Drawhead, casting only, 135 pounds; knuckle, 50 pounds; operating rod, 5 pounds; knuckle pin, 5 pounds; finger, 2¼ pounds; knuckle lock, 13 pounds.

Williams Coupler.—Dyer Williams, 1425 Monadnock block, Chicago, Ill. Bar, 148 pounds; knuckle, 40 pounds; lock, 4 pounds; other small parts, 6 pounds.

The Ajax, California, Champion, Diamond, Edwards, Empire, Eureka, Interstate, Johnston, Pacific, Taylor and Washburn coupler companies were asked to quote weights, but failed to respond.

JOURNAL BEARINGS AND HOT BOXES.

One of the topical discussions before the M. C. B. Association on journal boxes was opened by Mr. H. F. Ball as follows:

The present Master Car Builders' journal boxes, stop wedges, brasses and lids.

(a) It is claimed that the present shape of top wedge is a source of danger by throwing center of load outside or inside of center of journal, thereby concentrating load on one end or the other, instead of distributing it equally.

(b) A consideration of the general form of box and the present lid, which has not been entirely successful as a dust-proof covering.

(c) Limiting thickness of journal bearings when worn out.

"The top surface of the present M. C. B. key is in the shape of a cylindrical segment, the radius of the curve being 78 inches. When the journal box is in its normal position it is in contact with the key at its center, and load which it supports is distributed uniformly lengthwise of the jounral. Any necessary adjustment between the box, key and brass by reason of truck imperfections is obtained by a rocking motion of the box on top of the key. It follows that an adjustment obtained in this way necessarily implies an eccentricity of bearing between the box and key, resulting in increasing the unit of pressure at one end of the journal, and to such an extent at times as to seriously interfere with proper lubrication.

"In the examination of trucks that have been in service for some time it will be noticed that a large percentage of the boxes is inclined out of vertical. In most cases it will be found that the tendency of the box is to incline outwardly at the bottom, throwing the load toward the rear of the journal.

"In pedestal type of trucks this condition is very noticeable from the excessive wear which takes place between the pedestals and box guides at top of box. A further evidence of the want of uniformity in the distribution of the load is seen in the unevenly worn bearings, which are removed from time to time. It is well known that the rear end of the journal is the most difficult part of the journal to keep properly lubricated, owing to the tendency of the packing to shift out of positon, and also to the amount of grit and sand that is carried in the rear of the box. Add to these obstacles to proper lubrication the excessive bearing pressure at the rear end of brass, and we have a combination at work that sooner or later gives the inspector an opportunity to send in a report of a hot box, resulting from a "doubtful" cause.

"What is desired is a key or brass that will adjust itself to the inequalities of the truck, and at the same time maintain a uniform distribution of the load lenthwise of the journal. This condition cannot be obtained with the use of the present M. C. B. standard key."

In the discussion of the report of the committee on "Care of Journal Boxes," printed in abstract on page 247 of our July issue, Mr. A. M. Waitt made the following remarks:

"I looked up the record on the Lake Shore for the year 1897. Just after receiving that report (and I will say that hot boxes are something we watch closely and have a report on each case, not a hit or miss report, but a report that covers the case of every hot box that requires attention or causes delay to a train on the road) and we average one hot box for every 70,000 miles run. This was on passenger equipment. On freight equipment, with equal care, we had only one hot box in every 20,000 miles run. That result was not obtained without care. Were it not for the foreign cars running over the line which had not received proper care on the home lines, the mileage to a hot box would have been more than four times what it was. On the reports that came in on freight cars 80 per cent. were on foreign cars and 20 per cent. on our own cars. This shows the result of having systematic rules for guidance in the care of journal boxes and in watching the matter closely. If we have an excessive number of hot boxes on any division, as shown by the reports, attention is called to the matter and an explanation asked for. Invariably some good cause will be found for the excess, and that cause is removed and better results occur. I do not think we can have good results in running our journals unless we keep the dust out of the oil boxes. The committee has recommended excluding the dust from the front end of the box, and yet they seem to think that a common wooden dust guard, cut, as most of them are, from 1-16 to ⅛ inch larger than the part of the axle where they fit, will be satisfactory. You will find the waste in the oil box dirtier, more full of grit and sand at the back end than you do at the front end, with the many non-dust tight box covers at the present time. I would not publicly advocate any one dust guard to the exclusion of another. I believe it is worth while, however, to experiment with the many in the market, and find something that will be better than the common, crude dust guard, which is no protection to speak of to the box. I believe if some of the gentlemen who have in their answers advocated the wooden dust guard had experimented with other devices, they would have found some advantages in them. We find it desirable, or most essential as winter comes on, that all of the lighter summer oils used in the oil boxes be entirely removed from the waste. If the summer oils are left in the waste and the winter oil is allowed to mix with the other, as soon as cold weather comes the summer oil will thicken and the fibers of the waste which are filled with the oil will become non-conductors of the oil and the result is that your waste is stiff. The oil will not be fed by the waste to the journal box, and the waste will work away from the under side of the journals and you will have hot boxes. At the time of changing the oils it has been our practice for several years to remove the waste from the journal box and under a press squeeze out the light grade of oil, and put it aside until the following summer. We resaturate the waste with the winter oil, and after it has been saturated a long time, 48 hours or so, repack the box with it. We have found that the results since that practice is adopted have been very satisfactory. An excessive number of hot boxes seem to come right after a thaw, and it was found that when the weather had begun to be moderate there would be a collection of water inside the oil box, and in proportion to the amount of water that seemed to be in there—I suppose the condensation of the atmosphere—seemed to be the lack of lubrication of the journals and the increase of hot boxes. That was overcome by more frequent withdrawal of the packing and removal of the moisture. On some of the fast trains it has been found a wise practice, whenever there has been a moderation in the temperature after severely cold weather, to make sure, before these trains go out, that all of the water has been removed from the waste, and this practice has stopped the annoyance from hot boxes on such trains.

PERSONALS.

Mr. T. M. Downing has resigned as Master Mechanic of the Columbus, Sandusky & Hocking.

Mr. M. F. Bonzano, Superintendent and Chief Engineer of the Columbus, Sandusky & Hocking, has resigned.

Mr. W. R. Ellis has been appointed General Superintendent of the Hegewish shops of the Illinois Car & Equipment Company.

Mr. W. S. Alexander, President and General Manager of the Eastern Railway of Minnesota, a part of the Great Northern, died in St. Paul Sept. 4.

Mr. O. M. Laing, Cashier of the Seattle & International at Seattle, Wash., has assumed the duties of purchasing agent in addition to those of cashier.

Mr. W. A. Stone has been appointed Master Mechanic of the Detroit, Toledo & Milwaukee Railroad, vice, J. W. Witmer, resigned. Headquarters, Marshall, Mich.

Mr. Wilson Eddy, who was Master Mechanic of the Boston & Albany from 1850 to 1881, died at his home in Springfield, Mass., Sept. 2, at the age of 85 years.

Mr. John Foulk has been appointed Master Mechanic of the Litchfield, Carrollton & Western, retaining his present similar position on the Jacksonville & St. Louis.

Mr. Conrad Miller has retired from the Presidency of the Kansas City, Osceola & Southern, owing to the absorption of that road by the St. Louis & San Francisco.

Mr. W. H. Garlock has been appointed Master Mechanic of the White Pass & Yukon Railway, now under construuction in Alaska, with headquarters at Seattle, Wash.

Mr. E. W. How has been appointed General Agent of the Interoceanic Railway of Mexico, with headquarters at 29 Broadway, New York, and will also act as Purchasing Agent.

Mr. Frank Brown, assistant to the Purchasing Agent of the Baltimore & Ohio Southwestern, has been appointed Purchasing Agent of that road, with office at Cincinnati, Ohio.

Mr. Frank Cain has been appointed Master Mechanic of the Texarkana & Fort Smith, with authority to perform all duties pertaining to the office of Superintendent of Motive power and Machinery.

Mr. C. M. Stanton, General Manager of the Jacksonville & St. Louis, has been appointed General Superintendent of the Litchfield, Carrollton & Western also, in place of Mr. T. W. Geer, resigned.

Mr. Horace J. Morse resigned as President and Director of the Iowa Central at the annual meeting in Chicago, Sept. 2, and Mr. Robert J. Kimball, of New York, was chosen President to succeed him.

Mr. John W. Shannon, Inspector for the Westinghouse Air Brake Company, with headquarters in Buffalo, died in that city Sept. 10, aged 47 years. Mr. Shannon was connected with this company nearly twenty years.

Mr. Harry W. Frost, who has been General Sales Agent of the Monarch Brake Beam Company, with an office in the Old Colony Building, Chicago, has been made General Manager of that company, with headquarters at Detroit.

Mr. B. F. Bond has been appointed Engineer of Maintenance of Way of the Litchfield, Carrollton & Western, in addition to his duties as Engineer of Maintenance of Way of the Jacksonville & St. Louis. Headquarters, Jacksonville, Ill.

Mr. W. F. Walworth has resigned as President of the York Southern, owing to the reorganizing of that road, and Mr. Lafean of York, Pa., has been chosen to succeed him. Mr. Walworth has been President of the road since 1894.

Mr. B. S. Josselyn on Sept. 1 retired from the position of General Manager of the Kansas City, Osceola & Southern, owing to the transfer of that road to the St. Louis & San Francisco under a lease. Mr. Josslyn has been with the road since Jan. 1, 1893.

Mr. G. A. Gallagher has resigned as Roundhouse Foreman for the Duluth, South Shore & Atlantic Railway at Marquette, Mich., to accept the position of Mechanical Superintendent of the Duluth, Mississippi River & Northern, with headquarters at Swan River, Minn.

J. R. C. Wrenshall has been appointed Acting Division Engineer Maintenance of Way of the Baltimore & Ohio Railroad in charge of the Third Division, which extends from Cumberland to Grafton, vice George L. Hall, resigned. His headquarters will be in Cumberland, Md.

Mr. George R. Morse, heretofore Secretary and Treasurer of the Iowa Central, was chosen Vice-President of that road at the annual meeting in Chicago, Sept. 2, and Mr. S. Seaman Jones was elected Secretary to succeed him. Mr. E. E. Chase has heretofore been Vice-President. Mr. Morse continues as Treasurer.

Mr. B. S. McClellan, Foreman of the Car Building Department of the Illinois Central at New Orleans, La., has accepted the position of Master Car Builder of the Fort Worth & Denver City, with headquarters at Fort Worth, Tex., and is succeeded at New Orleans by Mr. Theodore W. Sloan, formerly located at Indianapolis, Ind.

Mr. C. M. Raymond, President of the Carbon Steel Company, announces that Mr. Nat C. Dean, who has heretofore represented that company and the Fox Pressed Steel Company jointly, has resigned as agent for the latter and will devote his entire attention to the interests of the Carbon Steel Company as Western Sales Agent, with offices in Chicago (1409 Fisher Building) and New York (Havemeyer Building).

Mr. H. R. Hobart, who for twenty-two years has been chief editor of the "Railway Age," has resigned. He has held the position ever since the paper was started, and he carried a large part of the heavy burden in the earlier days. He has many friends who will miss him, and we join them in wishing him success in his new line, which we understand is real estate business. His writings, which were voluminous in so long a newspaper career, are characterized throughout by conscientiousness and honesty. The "Railway Age" owes much of its success to him, and it will not be easy to find a successor as able and as well equipped.

Judge Thomas M. Cooley, who died at his home in Ann Arbor, Mich., Sept. 12, was one of the ablest and best known American jurists. He was born in Attica, New York, in 1824, and began studying law in Palmyra, N. Y., in 1842. In 1843 he moved to Adrian, Mich., where he was admitted to the bar in 1846. He practised law for about two years in Tecumseh, and in 1857 the work of compiling the General Statutes of Michigan was intrusted to him. He was elected a Justice of the Supreme Court in 1864, and in1869 was re-elected to fill a term of eight years. In 1868-9 he was Chief Justice, and in 1885 retired permanently from the bench. In 1881 a school of political science was established in the University of Michigan, and he assumed the professorship of Constitutional and Administrative Law. It was in 1882 that Judge Cooley's attention was first directed to the line of work that chiefly occupied him during the later years of his active life. At that time he was asked by the president of the Baltimore & Ohio, the Pennsylvania, Erie and the New York Central Railways to serve on a Board of Arbitration which was to settle the question of "the difference in rates that should exist both eastwardly and westwardly, upon all classes of freight between the several terminal Atlantic ports." Judge Cooley showed such distinguished ability in dealing with the perplexing problems of railway management that in December, 1886, he was appointed by Judge Gresham receiver for that portion of the Wabash Railway within his jurisdiction. When the Interstate Commerce Commission was organized in March, 1887, Judge Cooley was appointed by President Cleveland a member of that body, and it was in connection with its work that he became most generally known throughout the country. Originally appointed for the term of six years, he was elected the first Chairman of the Commission, and remained in that position until the expiration of his term, when he retired because of failing health. His capacity for work was wonderful. Besides his activities in the lines mentioned, he found time to write a number of exhaustive works on difficult legal questions, the first of which appeared in 1868. He was a student, a thinker, a candid, honest and clear writer and speaker, and in many ways was in advance of his time.

BOOKS AND PAMPHLETS.

"Poor's Manual of Railroads, 1898." Published by H. V. and H. W. Poor, 44 Broad St., New York. Price, $7.50.

The thirty-first annual volume of Poor's Manual contains the usual statistical summaries of the financial affairs and operations of the railroad systems of the United States, Canada and Mexico, and the book is so very well known as to require only the announcement that it is soon to appear. The new edition of the manual is 130 pages larger than the edition for 1897, and covers the statements of about 4,300 corporations having an approximate capitalization and debt of $16,500,000,000. Of steam railroads there are presented statements of 1,951 companies—1,782 in the United States, 152 in the Dominion of Canada, and 17 in Mexico. The department of city and suburban railways, comprising electric, cable and horse railroads, is covered by 1,187 corporate statements and contains information respecting these important enterprises. During the life of the manual the advance of the railroad interest has been marvelous, the ten years, from 1878 to 1887 inclusive, having been marked by an increase in the railroad mileage of the country of 87 per cent., while during the ten years since the close of 1887, though a period of constantly increasing depression, the increase for the whole United States has been about 24 per cent., the total mileage Jan. 1, 1898, equaling 184,500 miles. In 1895 the total investment was $11,362,985,080; gross earnings were $1,105,284,267, equal to 9.7 per cent. on investment, and net earnings, $327,505,716, or 2.9 per cent. on capital. Compared with 1895, gross earnings of all steam surface railroads (excluding elevated roads in New York, Brooklyn and Chicago) increased in 1896 $33,236,588, made up by an increase of $26,639,562 in freight earnings, of $4,383,517 in passenger earnings and $2,213,509 in mail, express, and other miscellaneous earnings. The total number of miles of railroad in the United States at the close of 1896 was 182,565; of which 2,025 miles were constructed during the year. The mileage of lines making returns of their share capital and funded and floating debts equaled 181,394, against 179,821 for 1895, the increase being 1,573 miles. In 1896 the tonnage moved on all the railroads of the United States equaled 773,868,716 tons; the tonnage mileage 93,885,853,634 miles, and the earnings therefrom $770,424,013—equal to 0.821 cent per ton per mile. In the fourteen years from 1882 to 1896, inclusive, the total freight movement of all the railroads of the country reached the enormous aggregate of 1,025,819,107,347 tons hauled one mile. For this service the railroads received as compen-

sation the sum of $9,370,973,748; but had the average rates that prevailed in 1882 been in force during this period, their earnings from this source would have been $12,679,124,168, or $3,308,150,420 in excess of the amount actually received. This enormous sum, averaging over $236,000,000 per annum, represents the amount saved to the public by the reduction in the charges for hauling freight. It also represents a revenue equivalent to four per cent. per annum upon an investment of nearly $6,000,000,000. The rapid substitutions of electric traction for animal power may be judged from the fact that since 1891 the number of horses employed in the street railway service has declined 170,275, nearly 90 per cent. The total length of the lines in the United States equals 16,089.87 miles, against 15,956.13 miles in 1896 and 13,176.38 miles in 1895, the latter sum being an increase of 3,514.32 miles over those in operation in 1891, so that in six years there have been built 6,427.81 miles of city and suburban tramway lines.

"The New Roadmaster's Assistant." A manual of reference for those having to do with the permanent way of American railroads. By George H. Paine. Published by "The Railroad Gazette," 32 Park place, New York. Bound in pantasote, pp. 262; illustrated; price, $1.50.

This book is a successor to the "Roadmaster's Assistant," written by Wm. S. Huntington in 1871 and revised by Charles Latimer in 1877. Its style is concise and direct, bringing the work of these writers up to date for the benefit of practical men. The author modestly refers to the work as a revision of these earlier ones, but it is really more than that, and contains much new matter. It is intended for the engineer, roadmaster and section foreman. The following list of subjects shows the scope: Organization and methods of work, fences, crossings, platforms, water supply, drainage, culverts, trestles and bridge floors, ballast, cross-ties, rails and fastenings, track work, tools, frogs, switches and stands, emergencies, train signals, fixed signals, rules and tables. The arrangement of the subjects, the wide margins and marginal captions for the paragraphs and the excellent engravings are good features, the engravings being remarkably good. They are from drawings made especially for the book, and we commend them as models to those who illustrate books of this character. We cannot say as much for the printing of some of them The author gives a deal of tabular matter in connection with frogs, switches and curves. These tables, we believe, were worked out with great care by the author, with a view of assuring their reliability. The book is practical and, probably because of lack of space, contains little of what might be called abstract theory. We find in the chapter on fixed signals one of the best general presentations of the subject that we have seen. It gives a great deal of information about signals that track men do not usually know and yet must know if they are to do their part in signal maintenance. We recommend the book as a good reference work, and we are glad to have a copy for consultation on the many questions that continually arise about track matters. Its greatest value is for roadmasters and engineers of maintenance of way. The book is worthy of a better binding and better lettering; these features are not in keeping with its character in other directions.

"A Pocket Book for Mechanical Engineers." By David Allen Low, M. I. M. E., Professor of Engineering, East London Technical College, London, New York and Bombay: Longmas, Green & Co.; 4 by 6 inches; 740 pages, over 1,000 illustrations and complete index. Price, $2.50.

Next to Kent's pocket book the one under review is the best that we have seen. It is particularly strong in the tabular matter and machine details. The tables are numerous and convenient and many are new. They may be used with confidence because the author states in the preface that both those that have been copied from other works and the new ones, of which there are many, have been carefully checked by two persons working independently. The engravings, most of which illustrate machine details, are clear, and the text is very concise. The book records a number of tests and experiments, some of them being taken from the proceedings of well-known societies, and these are valuable additions when put into such a convenient form. Considerable space is given to locomotive details, and boilers for locomotives, stationary and marine service. The arrangement of the work is good, it is well printed and serviceably bound. An impression of reliability and thoroughness is made at the first examination and it grows as the book is used. Every designer and draftsman should own it. The New York address of the publishers is 91 Fifth avenue.

"Practice and Theory of the Injector," by Strickland L. Kneass, C. E., Member A. S. M. E. Second edition. New York, John Wiley & Sons, 1898.

To those who have copies of the first edition of this work it is sufficient to say that it has been improved, enlarged and brought up to date. To those who do not know the book it is enough to say that it is the only satisfactory work on the injector. Mr. Kneass is good authority on the subject, and has presented the historical, theoretical and practical sides without going into useless depths of mathematics. The work is strong in results of practical tests and in methods of testing. The concluding chapter is devoted to the care of injectors and their use on locomotives.

"American Street Railway Directory." First Volume, No. 1. Published quarterly by E. L. Powers, New York and Chicago.

This is the first volume of a directory of officials, equipment, power and finance of the United States and Canada. It is standard size (6 by 9 inches), and has 90 pages of classified information pertaining to street railways. It also presents a summary of the street railways of the country. It will be very convenient for those who transact business with these roads.

"Report of the Proceedings of the Thirty-first Annual Convention of the American Railway Master Mechanics' Association Held at Saratoga, N. Y., June, 1898."

The proceedings of this organization are too well known to require special comment, except upon their prompt appearance. The volume reached us less than seventy days after the convention, and considering the vast amount of labor necessary to get the matter ready for the press, this is extraordinary. The volume is in the usual form.

Lectures at Purdue University.—We have received a number of pamphlets containing the lectures of men in successful business life that were delivered before the students of Purdue University during the year 1897-98. There were eleven lectures, all but two being put on record in these pamphlets. The subjects are as follows: "Problems in the Management of a Railroad System," by Mr. J. T. Brooks, Second Vice-President, Pennsylvania Lines West of Pittsburgh; "The Past, Present and Future of American Railroads," by Mr. M. E. Ingalls, President of the Cleveland, Cincinnati, Chicago & St. Louis; "The Mutual Obligations of Railroad Corporations and the Public," by Mr. John W. Noble, ex-Secretary of Interior; "Relation of Railroads to the State," "Railroads and the People" and "Railroads and Their Servants," the three by Mr. Addison C. Harris, Attorney at Law; "Business Problems of the Motive Power Department," by Mr. Robert Quayle, Superintendent of Motive Power, Chicago & Northwestern; "Railroad Signaling," by Mr. F. A. Delano, Superintendent of Freight Terminals, Chicago, Burlington & Quincy; "Car Designing and Construction," by Mr. A. M. Waitt, General Master Car Builder, Lake Shore & Michigan Southern. We understand that copies of the pamphlets may be had on application to the Secretary of Purdue University, Lafayette, Indiana.

"Protective Coatings for Iron and Steel." This is a 15-page pamphlet by W. W. Lawrence & Company, Pittsburgh and Buffalo.

The importance of protective coatings and the differences of opinion among authorities as to the best methods to be adopted are first pointed out and the pamphlet in clear, concise language, gives statements in regard to the following subjects: 1. The manner in which paints on metal surfaces fail. 2. The causes for such failures. 3. The qualities required in a successful protective coating. 4. How these qualities are secured in the use of the permanent paints furnished by this company. The main part of the pamphlet is valuable entirely aside from the fourth subject just mentioned and is worthy of preservation for its clear treatment of the general problem of preservation, and the application of the premises to the product of these manufacturers is equally clear. Paints usually fail by powdering, peeling and blistering and by cracking. The causes are improper condition of surface, improper materials in the paint, improper binding material, improper shop methods and causes which lie outside of the materials and methods used. The opinion of the authors is supported in many of the statements by quotations from well-known authorities.

One weakness in most paints not generally understood is the presence of minute pores which only the microscope reveals, and these cause rapid deterioration by permitting the absorption of water, which is the most general and most powerful influence in destruction of metallic structures. The text says: "Hence we say that the successful protective coating for iron must not be porous but present instead a glossy enamel-like surface that will effectually prevent absorption of moisture." The effects of galvanic action, of waste by gaseous action and heat are also noted. A little more than half the space is entirely free from references to the Lawrence paints, and the application of the principles is then stated logically and plainly. The basis for these paints is red lead and the objections to this type of paints are reviewed and met by statements as to how the objections have been overcome in the manufacture of the "Permanent Paints." The "Lawrence Asphaltic Bridge Conservative" is one of the paints described. This coating is prepared in accordance with a formula by Dr. C. B. Dudley, chemist of the Pennsylvania Railroad, and a frequent contributor to the "American Engineer" on paints and other subjects. The special qualifications for protecting surfaces primes with "Lawrence's Permanent Paints" are stated, after which attention is given to the materials used in these paints, and the pamphlet closes with brief specifications recommending their use in first, second and third coats.

"Painting on Metal, with Specifications." By A. H. Sabin. Published by Edward Smith & Co., 45 Broadway, N. Y.

This is a little book of 84 pages printed primarily to interest people in the product of the publishers. The work is divided into four parts or chapters, the first of which is introductory and treats of the general principles of protection of metallic surfaces. The second gives a set of specifications for high-grade work such as important bridges and permanent construction work. The third presents specifications for what is termed ordinary work, not requiring a sand blast preparation. These specifications were carefully prepared with the aid and suggestion of a number of prominent engineers. The "Durable Metal Coating" is too prominently mentioned in the specifications to give any idea of disinterestedness. At the end of the book is a chapter on this paint and the claims made for it. The book is expensively gotten up and contains a great deal of valuable information and a number of excellent engravings. It is bound in leather and is worthy of preservation.

The New Britain Machine Company, New Britain, Conn., have sent us catalogues of Case Steam Engines and Chain Saw Mortisers. Both of these are standard size, and are unusually complete in the information given concerning these products, the sizes of the machines, floor space occupied and other data necessary in purchasing being given. The Case engines are shown in large variety, with pedestals and wall brackets and hangers, with throttling and automatic cut-off governors. They may be mounted on the floor, on a floor foundation, on the side of a wall, or they may be suspended from the under side of an overhead beam These engines are inclosed, and are very neat and compact and light. They have large wearing surfaces, automatic lubrication and good regulation, the design being made specially with reference to high speed, little wear, low cost for repairs and long life. The reciprocating parts of an eight horse power engine weigh 11 pounds, one-half of which is counterbalanced by the crank. The manufacturing facilities of the builders are excellent, and those desiring small steam powers for machinery or direct connection to electric generators or fans will do well to send for the catalogue. The chain saw mortisers are described as fully as the engines. The mortise is made by a steel chain, each link of which has a sharpened tooth formed to carry out its own chip. The chain travels about 1,500 feet per minute, and the cutting is clean and very rapid. The chips are sucked away by a fan, driven by the sprocket that drives the chain. The output is high, on door work users report cutting from 80 to 120 door stiles per hour, other work being in proportion. The special claims made are given in detail in the pamphlet, together with statements of capacities and dimensions of each style and size of machine. We should say that the larger sizes of these machines would be valuable in car work. This concern has a large domestic and foreign trade in engines and the chain mortisers. They have also supplied them to the United States Government.

"The Lake Shore Limited." — An advance copy of an illustrated booklet, descriptive of "The Lake Shore Limited," the new twenty-four hour train betweeen New York, Boston, Cleveland and Chicago, via the New York Central, Boston & Albany, and Lake Shore Railroads, has been received from Mr. Geo. H. Daniels, General Passenger Agent of the New York Central. This booklet is from the press of the American Bank Note Company, and, in addition to new illustrations and a brief description of the cars and their appointments, a map of the route, and time tables, it contains a feature not heretofore made use of in railroad advertising, which is a descriptive time table, detailing in concise language the principal objects of interest that may be seen from the observation car from time to time as the train progresses on its daily journey. For intance, each river is named, and the reader is told where it rises and where it empties, he is informed what railroad he crosses, the name of the towns passed. The illustrations show the interior of this magnificent train. A copy can be obtained by application to Mr. Daniels, addressed Grand Central Station, New York.

The Joseph Dixon Crucible Co., Jersey City, N. J., has just issued a little pamphlet, entitled "Helps in Brazing." It treats incidentally of brazing graphite, the application of which to bicycle tubes prevents the adherence of the spelter and so effects a saving in labor by making unnecessary the filing which is otherwise needful. The pamphlet, however, especially treats of the process of brazing by the dipping method, or "liquid brazing," as it is called. The brazing crucible is described, together with instruction and caution in regard to its use. Instructions are given how to build and set the necessary furnace, time required for brazing, etc. The pamphlet will interest all who have brazing to do, and it will be sent upon application.

"What They Think of the New Baltimore & Ohio Railroad."—This title is borne by a pamphlet recently issued from the office of Mr. J. H. Maddy, Press Agent of the B. & O., at Baltimore. It is illustrated with excellent and striking half-tone engravings of the improvements made on this line, and contains reprints of articles written by newspaper men after several daylight rides over the line during the first week in July. The pamphlet will convince the reader that this road has greatly improved under the present management. The engineering work in improving the line has been carried out on a very broad and liberal scale, the efforts being specially directed toward improving the operating conditions for the benefit of the stockholders.

"Hunt Automatic Railway."—This catalogue, issued by the C. W. Hunt Company, 45 Broadway, New York, is known as No. 9,806. It illustrates and describes the railway equipment manufactured by this firm for the purpose of handling coal ore, merchandise and loose material in general. Half tone engravings and line drawings illustrate the appliances and methods used for the handling of material by railways. Those who have not studied the excellent methods of manufacture of these appliances will be interested by the pamphlet, and all who have the handling of coal or similar material should procure it.

The "U. S. S. Oregon" is the subject of an attractive advertisement in colors, recently received from the Peerless Rubber Manufacturing Co., 16 Warren street, New York. The purpose of the engraving, 14x20 inches in size, is to direct attention to the fact that the use of "Rainbow Packing" in all of the packing joints, piston and valve rods on this fine ship contributed to her wonderful performances during the war with Spain. We have directed attention to her continuous run of over 13,000 knots, and her burst of speed at Santiago. There is no doubt of the value of such details as good packing as leading to the unparalleled achievements of this ship. A copy of the picture may be obtained by every engineer on application to this company.

The J. G. Brill Company, Philadelphia, has issued a pamphlet, dated September, 1898, in which the new "Dedenda Gong" is illustrated and described. This is a new mechanism for operating gongs on street cars, which is a great improvement upon the devices generally used. The plunger, or treadle, has a large head, so arranged as to lock down flush with the floor when not in use. The whole arrangement is self-contained, and

may be attached by any carpenter. The details have been worked out to make the sounding of the gong clear and the mechanism very simple.

"A Quarter Million Horse Power of Polyphase Electrical Transmission Apparatus."—This is the title of a pamphlet received from the Westinghouse Electric & Manufacturing Company of Pittsburgh. The pamphlet contains data in regard to 185 electric power plants distributed through 29 states and eight foreign countries. The distances through which transmission is carried range between one and 78 miles. The pamphlet illustrates the largest work of this concern at Niagara Falls by means of handsomely executed engravings.

"The Hunt Cable Railway for Handling Coal and Merchandise," is the title of a 20-page illustrated pamphlet received from the C. W. Hunt Co., 45 Broadway, New York. It describes, with the aid of half tone engravings, a number of large coal and merchandise handling plants built and installed by this company of engineeers and gives a great deal of information of value to those who have to do with the transportation and handling of loose material. The catalogue is known as No. 9,803.

The San Francisco Bridge Company and New York Dredging Company have sent us a copy of an illustrated pamphlet showing a number of examples of heavy and important engineering and dredging works carried out by them. The pamphlet is a partial record of their undertakings, many of which are well known. The office of the Bridge Company is 42 Market street, San Francisco, and of the dredging company, World Building, New York.

PRATT INSTITUTE TWO YEAR COURSES.

Mr. Arthur L. Williston, Director of the Department of Science and Technology of Pratt Institute, Brooklyn, has sent us circulars describing the newly-inaugurated two year courses of that institution. They are not intended to take the place of elaborate four year courses, involving a large amount of preparation, but rather to prepare students in a short time in mechanical electrical subjects, so that they may take places of responsibility in these lines if they cannot afford the time for more extended courses.

Drawing, machine design and applied electricity are covered in the two years work. The drawing includes projection, intersections, mechanism, and finally machine design. Shop work, study of iron and steel manufacture and strength of materials follows the drawing. In applied electricity the course covers physics, heat and laboratory practice in the use of electrical machinery.

Particulars of the courses may be obtained from the Secretary of Pratt Institute, Brooklyn, N. Y.

EQUIPMENT AND MANUFACTURING NOTES.

At the shops of the Rock Island, in Horton, Kan., recently, the work of erecting an engine was completed in 7 hours and 15 minutes from the time that the boiler was received.

Simplex body and truck bolsters, manufactured by the Simplex Railway Appliance Co., the Fisher Building, Chicago, were specified for 300 flat bottom coal cars for the Southern Railway recently.

The Louisville & Nashville has been obliged to provide its north and south division with ten additional engines in order to take care of the heavy freight business that is now being done.

During the past two years the receivers of the Baltimore & Ohio Railroad have increased the yard and siding facilities to the extent of 102.46 miles on the lines east of the Ohio River. While a great deal of this mileage is addition to the yard room, a very large number of short side tracks were laid for the benefit of industries along the line.

The Westinghouse Electric & Manufacturing Company of Pittsburgh and the Walker Company of Cleveland have consolidated, the Westinghouse capital stock being $15,000,000 and that of the Walker Company $2,500,000. The street railway business is now controlled by this combination and the General Electric Company.

Westinghouse electro-pneumatic interlocking apparatus is being put in at Whitechapel, London, on the Great Eastern Railway.

The Chicago Pneumatic Tool Co. has received orders for 36 pneumatic tools and 3 air compressors to go to Japan. A second order for riveters, hammers and drills has been received from the Imperial Chinese Railway, and these, with many home orders, including machines for the United States navy yards, keeps the concern exceedingly busy.

The Q & C Company have an interesting exhibit at the Trans-Mississippi Exposition at Omaha, which is attracting a great deal of attention. It is under the charge of Mr. Jesse Whittall, and we are informed that a number of orders have been received from persons who have seen it. The specialties known under the designation "Q & C" are as follows: Brake shoe keys, journal box lids, shop saws, freight car doors with Wood's seal lock, pneumatic oil distribution system, Scott boiler feeder and Stanwood car steps, besides which the exhibit includes Bryant rail saws, compound lever jacks and the Servis tie plate.

There has been a great deal said in newspapers lately about the discontinuance of "The Lake Short, Limited," the New York Central's twenty-four hour train between New York and Chicago. There is no truth in this rumor. We are informed that "The Lake Shore, Limited," will continue to run every day in the year over the New York Central & Hudson River and Lake Shore & Michigan Southern Railroads—the same tracks that carried the Exposition Flyer, between New York and Chicago, in twenty hours, for 175 days during the World's Fair.

The incorporation of the Federal Steel Company, September 9, under the laws of New Jersey, with capital stock of $200,000, is an event the whole meaning of which can not now be appreciated or even stated. The company has power to do almost all kinds of business in any part of the world, and its influence on the manufacture of iron and the interests involved therein may be expected to be a powerful one. The incorporating companies are: The Illinois Steel Co., the Minnesota Steel Co., the Elgin, Joliet & Western Railway, the Lorain Steel Co., and the Johnson Steel Co. It is reported that the Carnegie interest is included, but this is not known at this time.

The Holland Company, Pittsburgh, has issued an illustrated descriptive circular of their facilities and methods of renewing and rerolling steel rails. The renewing process is to cut off the worn ends of rails and re-drill them for the angle bars, and the rails are sorted according to the heights to which they are worn for convenience in relaying. The salvage from the worn ends is applied to the cost of renewing. When orders are large enough, they are prepared to move the plant to the works to save expense in transportation. A plant has been built at Wheatland, Pa., and orders are now on hand to keep it busy for a long time.

Col. W. H. Powell of the Ninth Infantry, United States Army, has addressed a letter to the passenger department of the New York Central, in which he said: "It is with great pleasure that I take the earliest opportunity to acknowledge the courtesy and consideration shown my command in its recent trip over the New York Central by every official of the road. I have been traveling with troops over railroads off and on for some thirty-seven years, and I do not hesitate to say that the most comfortable and rapid trip I ever made in all these years is the trip over your road, which you were so kind as to personally supervise."

A telephone experiment is to be tried upon the Baltimore & Ohio that will involve using the telephone for long distance communication. Work will begin in a few days on the construction of the new copper telegraph lines between Baltimore and Pittsburg, 340 miles, and they will be so arranged that when the necessity arises they will be available for telephonic communication. One of the wires will be extended as far as Newark for telegraphic use. A new line has also been constructed between Columbus and Cincinnati. It will take 300 miles of copper wire, weighing 166 lbs. to the mile, to complete the work.

The experiment of the Illinois Central to induce its employees to invest in the stock of the company seems to have proved a greater success than the company expected. The men have bought freely, and no one hears of dissatisfaction among them in regard to wages or other cause of grievance.

Mr. Francis R. F. Brown, M. I. M. E., formerly Mechanical Superintendent of the Intercolonial Railway of Canada, has opened an office as Consulting Mechanical Engineer at 22 Street Railway Chambers, 574 Craig street, Montreal. He will make a specialty of inquiries, assessing fire losses of machinery and plants and general mechanical engineering business. Mr. Brown's extensive experience qualifies him admirably for professional work of the highest character.

The Westinghouse Machine Company very generously tendered a banquet to the members of the National Association of Stationary Engineers attending the seventh annual convention at Pittsburgh, September 17, and opened their works for inspection by the visitors. The visit was interesting and instructive, and was thoroughly enjoyed. Among the features of interest was the large 750 H. P. Westinghouse gas engine in operation. The opportunity to see these works is an unusual one, which was appreciated. The plan of enabling men who run and care for engines to see the process of construction is commendable. About 600 visitors took advantage of the opportunity.

Pictures of two interesting Baltimore & Ohio Railroad buildings have been reproduced in a recent issue of "Truth." One is the building at Frederick, Md., which has been used since 1831 as a freight station, and which is still devoted to that purpose. In the little cupola of the building a bell once hung which was always rung on arrival of trains from Baltimore when horses were the motive power of the railroad. The other building is the station at Mount Clare, Baltimore, and it is noted as being the location of the first telegraph office in the world. It was from this building that Prof. Morse sent his celebrated message in 1844 to his friends in Washington, forty miles away.

The Westinghouse Electric & Manufacturing Company has taken a contract for machinery to go to China. Consul Ragsdale of Tientsin, under date of July 9, 1898, speaking of the arrival of the new United States Minister, Mr. Conger, mentions the general popularity of Americans in China. Expressions of friendship for our people, he says, are heard in official and business circles. He notes a contract just made by a representative of the Government with Mr. Difenderfer of Philadelphia, for the purchase of all machinery necessary to establish an up-to-date woolen mill at Tientsin. The electric machinery will come from the Westinghouse Electric Company of Pittsburgh, the boilers and engines from the Harrisburg Foundry & Machine Company, and the remaining machinery from the James Smith Woolen Machine Company of Philadelphia.

Purdue University entered upon the work of a new term Sept. 14 under conditions favorable to an excellent year's work. The engineering laboratory has, during the summer, been supplemented by the addition of a room 50 by 100 feet, known as the "Railroad Laboratory." In this room the equipment of machines for testing strength of materials and the brake shoe testing machine of the Master Car Builders' Association are already in place. There is also a fine full-sized model of the front end of a Richmond compound locomotive and an exhibit of typical steel car trucks. The equipment of this room will be completed during the Fall by the installation of the air brake testing rack of the Master Car Builders' Association. The number of students matriculating for the new year is larger than for several years past. The freshman class will number about two hundred, nearly two-thirds of whom are in the engineering courses. There are but few changes in the corps of instructors in the engineering department. Mr. Leopold O. Danse, for several years Senior Instructor in Mechanical engineering, Lehigh University, has been appointed an instructor in machine design, and Mr. Robert S. Miller, assistant in the engineering laboratory, has been made instructor in the mechanics of machinery.

OUR DIRECTORY

OF OFFICIAL CHANGES IN SEPTEMBER.

Baltimore & Ohio.—Mr. J. R. C. Wrenshall has been appointed Acting Division Engineer Maintenance of Way, vice Mr. George F. Hall, resigned. His headquarters will be in Cumberland, Md.

Baltimore & Ohio, Southwestern.—Mr. Frank Brown has been appointed Purchasing Agent, with office at Cincinnati, Ohio.

Beaver Meadow, Tresckow & Boston.—Mr. Israel Platt Pardee has been elected President, vice A. S. Van Wickle, resigned.

Columbus, Sandusky & Hocking.—Mr. T. M. Downing has resigned as Master Mechanic, and the duties of the office will be assumed by the Superintendent.

Columbus, Sandusky & Hocking.—Mr. M. F. Bonzano, Superintendent and Chief Engineer, has resigned.

Columbus, Ohio River & Tidewater.—Mr. William Kirkby of Toledo, President of this road, has resigned in order to become a member of the construction company. Mr. L. H. Altimus of Ripley, Ohio, has been elected President to succeed him.

Chicago Junction.—Mr. J. B. Cox has been appointed Chief Engineer, with office at Chicago, Ill., vice Mr. C. W. Hotchkiss.

Central Ontario.—Mr. H. S. Johnson has been elected Vice-President, vice Mr. H. P. McIntosh of Cleveland, Ohio.

Detroit, Toledo & Milwaukee.—Mr. W. A. Stone has been appointed Master Mechanic, vice Mr. J. W. Witmer, resigned.

Duluth, Mississippi River & Northern.—Mr. G. A. Gallagher has been appointed Mechanical Superintendent, with headquarters at Swan River, Minn.

Fall Brook.—Mr. Daniel Beach has been chosen First Vice-President, to succeed John Lang, deceased, and Mr. John H. Lang has been elected Second Vice-President. Mr. Wm. Howell has been made Assistant Treasurer.

Fort Worth & Denver City.—Mr. B. S. McClellan has been appointed Master Car Builder, with headquarters at Fort Worth, Tex.

Galveston, La Porte & Houston.—Mr. T. W. House has been appointed Sole Receiver of this company on account of the death of Mr. M. T. Jones.

Georgia & Alabama.—Mr. E. E. Anderson, heretofore Train Master, has been appointed Purchasing Agent and Assistant to General Manager Gabbett at Savannah, Ga.

Illinois Central.—Mr. L. A. Washington, heretofore Assistant Superintendent of the Evansville District of the Louisville Division, with headquarters at Evansville, has been appointed Assistant Engineer of the Louisville Division, with headquarters at Henderson, Ky.

Interoceanic Railway of Mexico.—Mr. E. W. How has been appointed General Agent, with headquarters at 29 Broadway, New York, and will also act as Purchasing Agent.

Iowa Central.—Mr. Robert J. Kimball has been chosen President, to succeed Mr. Horace J. Morse, resigned. Mr. Geo. R. Morse has been chosen Vice-President.

Kansas City, Osceola & Southern.—Mr. B. S. Josselyn has retired from the position of General Manager, owing to the transfer of that road to the St. Louis & San Francisco. Mr. Conrad Miller has retired from the Presidency, for the same reason.

Litchfield, Carrollton & Western.—Mr. C. M. Stanton has been appointed General Superintendent, in place of Mr. T. W. Geer, resigned. Mr. John Foulk has been appointed Master Mechanic, retaining his present similar position on the Jacksonville & St. Louis. Mr. B. F. Bond has been apponited Engineer of Maintenance of Way, in addition to his duties as Engineer of Maintenance of Way of the Jacksonville & St. Louis; headquarters at Jacksonville, Ill.

Southern Indiana.—Mr. F. B. Ogden has been elected Vice-President, with office at Chicago, Ill.

Seattle & International.—Mr. O. M. Laing has assumed the duties of Purchasing Agent, in addition to those of Cashier.

Spokane Falls & Northern.—Mr. A. Jackson has been appointed Resident Engineer, with headquarters at Spokane, Wash., in place of Mr. E. J. Roberts, Chief Engineer, resigned.

Texarkana & Fort Smith.—Mr. Frank Cain has been appointed Master Mechanic, and will perform all duties pertaining to the office of Superintendent of Motive Power.

Wabash.—Mr. W. A. Bell has been appointed Master Mechanic of the Wabash Terminals in Chicago.

White Pass & Yukon.—Mr. W. H. Garlock has been appointed Master Mechanic, with headquarters at Seattle, Wash. The road is now under construction in Alaska.

York Southern.—Mr. W. F. Walworth has resigned as President, and Mr. Lafean, of York, Pa., has been chosen to succeed him.

WANTED.

Back volumes of the "American Engineer and Railroad Journal" and the "American Railroad Journal," especially 1842, 1867, 1882 and 1889. Address "N. S. B.," Room 1214, 40 Exchange Place, New York City.